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[OFFICIAL NOTICE.]

Appointment of a Committee of Reception by the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

The following named members of this Association are appointed and respectfully requested to serve as a Committee of Reception, whose duty shall be to call upon all foreign gas engineers visiting our country during the continuance of the World's Fair at Chicago, whose names and addresses may be obtained, and to introduce them to other members of our profession, see that they obtain permits to visit the neighboring gas works and other objects of interest, and generally to make their stay in New York as pleasant as possible, and when they leave for Chicago, to give them letters of introduction to the Committee of Arrangements at Chicago: Messrs. Wm. Henry White (chairman), Eugene Vanderpool, William H. Bradley, Fred. S. Benson, William R. Beal, Thos. F. Rowland, Jr., Fred. W. Floyd and Oscar Weber.

The Guild of Gas Managers and the Society of Gas Lighting are respectfully requested to co-operate with this committee in extending hospitality to our visiting professional brethren.

A. E. BOARDMAN, President.

A. B. SLATER, JR., Secretary.

[OFFICIAL NOTICE.]

The American Gas Light Association's Greeting to European Gas Engineers.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

To the European Gas Engineers—Greeting: The American Gas Light Association will hold its 21st annual convention in the city of Chicago, beginning on the date of Wednesday, October 18th, 1893. It would give the members of the Association great pleasure to meet there as many of the European gas engineers and managers as can make it convenient to be in attendance at the World's Fair at that time. It is suggested that all contemplating visiting the Fair arrange their visits so as to be in Chicago, if possible, at the time of this convention, when they will be most cordially welcomed by the Association and invited to attend the sittings of the body and participate in its discussions of papers presented.

Those engineers who cannot conveniently visit the World's Fair at that time, but must choose some other date, are respectfully requested to send their names and addresses, as soon as they arrive in America, to the AMERICAN GAS LIGHT JOURNAL, No. 32 Pine street, New York City, so that a committee from the Association may be made aware of their presence, and when they may be met, so that they may form the acquaintance of their professional brethren in this country and be made to feel less like a "stranger in a strange land."

A. E. BOARDMAN, President.

A. B. SLATER, JR., Secretary.

BRIEFLY TOLD.

SOMETHING ABOUT GAS SUPPLY AT ALBANY, N. Y.—In our issue of June 26th (page 927, second column) some report was given of a hearing before the Law Committee of the Albany Common Council, on the petition of certain named parties, who sought a franchise for a corporation, to be known as the Albany Light and Power Company, which proposed to construct and operate a gas works in competition with the existing Municipal Gas Company of that city. While the arguments advanced for and against the proposition did not differ greatly from the ones usually put out on similar occasions, and while we do not believe that, remembering the favor with which the Municipal Company is regarded by the political clique at present in charge of the municipal affairs of the capital of the State, the seekers for the franchise will receive a favorable report on their petition, the very fact of the petition having been presented goes to show that the capitalists or speculators, whichever they may be, having looked the field over carefully, have come to the conclusion that there is profit in the proposed or actual operation of another Company in Albany. It is easy to understand where the readiest profit in such a scheme would come in; and that avenue for gain by the unscrupulous speculator is the broad one of obtaining a charter or franchise to dispose of to the owners of the Municipal Company, without ever a real thought on the part of its promoters to build a works. Still, apart from the unlikelihood that the authorities of the city would grant the required permission, it is more than problematical whether the proprietors of the Municipal Company could afford to purchase charters or franchises, for they are now operating a business that is pretty well loaded with stocks and bonds. The Municipal Company's capital stock amounts to $2,000,000, and its bonded indebtedness amounts to half a million more, so anyone at all conversant with the situation will admit that the gas field there is salted for all it will absorb. Thus the piling up of additional capital does not seem to be at all possible, unless the Company is to be overloaded to the danger point. The organization and operation of a Company, the works and complete plant of which would represent an investment of capital equal to a dollar of plant for a dollar expended in its construction and placing, would no doubt cause much trouble and loss to Mr. Brady and his associates, and in the long run might bring disaster to them in the shape that their opponents might be enabled to stand as the exemplars of the survival of the fittest—very much as Mr. Brady and his associates stood when some years ago they "went gunning" for the two original Companies—the Albany and the Peoples. Putting aside all mere speculation, however, it is not difficult to determine the cause of the present unrest in gas matters at Albany, nor to discover a cause that attracts attention of speculators to the matter of gas supply there. In very few words, the cause of it all is the high—the abnormally high—gas rates which rule. The average price received by the Company for gas sold and used for illuminating purposes at the present time is $2 per 1,000, and the charge for gas used for fuel purposes is $1.50 per 1,000. Such charges are standing menaces to the prosperity of the Company, and also to the prosperity of the other Companies of the State. All things considered, a general rate of $1.50 per 1,000 at Albany would be none too liberal, and we venture to say that the Company, did it see fit to institute such a rate, would, at the end of a twelvemonth, under the suggested new conditions, be in the receipt of a gross income considerably greater than it now enjoys, and that its home position would be greatly advanced respecting the opinions entertained towards it by those which it served, and that it would be less of a disturbing factor to the rest of the Companies of the State. Manifestly high prices for gas in a large city cannot fail to attract the attention of speculators and cranks, the first of whom seek to use the same as a wedge for their blackmailing schemes, while the second gleefully and noisily hold the figures up as a convincing proof that gas supply *all over* the State ought to be made a matter of municipal concern—in fact, figures of this nature are ammunition for the cranks of the country at large, who are ever anxious to seize the worst example in the world for the purpose of illustrating their own peculiar case at home. It is also a matter of note that as a gas consuming city of the first class in New York, taking as the basis five cities, and not including New York or Brooklyn, the average gas consumption per annum per head of population at Albany is only 8, the standard of the others being put at 10. This shows plainly enough that something is wrong in the management of Albany's gas supply, and we incline to the belief that the main trouble is in the rate charged. While we do not believe that an opposition Company would result in the permanent lowering of gas rates at Albany—in fact, that would be about the surest method of causing them to remain "where they are at" for many a month to come—and while we do not believe there is any great danger of the granting of an opposition franchise, we nevertheless hope that the proprietors of the Municipal Company will shortly see their way clear towards ordering a substantial concession to the consumers, on the ground that it would fortify them at home and eventually be of sustenance to the gas interests at large of the State. Whether this be done or not, the positive present fact remains that the gas rate at Albany is far too high.

[Concluded from page 5.]

The Inaugural Address Delivered by the President (Mr. Denny Lane, M. A.) at the Thirtieth Annual General Meeting of the Incorporated Gas Institute.

The latest proposal is what is called "Thermal Storage," by which it is intended to store heat in the form of water, under very high pressure, in strong wrought iron vessels—in fact, auxiliary boilers without fires—which would be stocked with water heated by other ordinary boilers working all the 24 hours. This project has been devised by Mr. Druitt Halpin, and is spoken of rather favorably by Professor Unwin. In the case of a central station, it is stated that at mid-winter 2,000 effective horse power were required to meet the maximum demand, and 10 large boilers should be provided; whereas, if the heat could be stored, 3 similar boilers working for 24 hours would be sufficient. Mr. Halpin proposed to store the heat generated in the three active boilers in 24 wrought iron vessels, 8 feet in diameter and 30 feet high, raising the temperature to 406° F. At the time when the thermal storage was partially exhausted, the temperature fell to 347°, to be raised again to 406°; and it was calculated that, with this range of temperature, 16 lbs. of water would furnish 1 lb. of steam at 130 lbs. absolute pressure. Taking 18 lbs. of steam per horse power, we should, therefore, store up 18 × 16 = 288 lbs. of hot water at a temperature of 406° F., and a pressure of 265 lbs. absolute, for each horse power required. At present the 10 boilers used cost £10,300; while 3 boilers and 24 high pressure storage tanks would cost £15,000. But if by the arrangement ½ lb. of coal per effective horse power were pared, the annual saving would be 1,270 tons of coal. This shows the power consumption to be 5,689,600 horse power hours a year, or 15,600 horse power hours a day. Now if we divide this by 2,000 effective horse power, it would seem that, in mid winter, the demand was equal to 8 hours of the maximum capacity.

I may add that Mr. Halpin suggests that the waste heat escaping from our retort benches might be utilized for heating the water in his storage tanks; and, taking the escaping furnace gases at 1,200° F., he estimates that the quantity of heat passing away into the chimneys of our gas works would supply 30,000 effective horse power night and day all the year round. But I think he must have taken our temperatures, and felt our pulses, before the regenerative system had been adopted; for, under such a system, no temperature so high as 1,200° reaches the chimney. At the same time, I believe that, if the draught were not too much impeded, some of the escaping heat might be picked up and utilized. Mr. Halpin estimated that it required 319 lbs. of coke to carbonize a ton of coal, or more than 14 lbs. per 100 lbs. of coal. This, of course, exceeds the quantity necessary in best modern settings.

To the complications and heavy initial expense of Mr. Halpin's system, some addition may be requisite on account of working for 24 hours instead of 6 or 8 hours; but the proposal puts an additional grave accent over the already sufficiently grave difficulty of the load factor.

Now the question arises: Is there any possible solution of this question? I answer at once that there is an easy and a ready solution; and that solution, gentlemen, is in *your* hands. Instead of storing chemical force in accumulators, water at a great elevation, or water at a very high pressure, store *gas*, employ it in gas engines, and the question is solved. Years ago I proposed this as the most economical system of supplying the electric light; and I was greatly gratified to find that so high an authority as Professor Kennedy has lately recommended the same system to the corporation of the city where we are now assembled. Let us see what capital will be required. For six months of the year, every well designed gas works has storage to spare; so that we have to provide additional gasholder room for the winter only. Under ordinary circumstances, I suppose I may put down the cost of a gasholder at £12 10s. per 1,000 cubic feet; and charging 8 per cent. for interest and depreciation, this will come to about £1 a year. If filled and emptied 240 times a year, the cost of storage would be only 1d. per 1,000 cubic feet, or if filled 120 times—or, say once a day for 4 months—the cost would be 2d. per 1,000 cubic feet. What will these 1,000 cubic feet do? At 25 cubic feet per effective horse power, or 33⅓ feet per kilowatt, we get by means of a gas engine 40 horse power, or 30 kilowatts, for a cost of 2d. for storage. So that, supposing you have to put up a new holder for that purpose, the outlay would be $\frac{1}{15}$th of a penny for every Board of Trade unit. But I go further, and say that this storage costs less than nothing, if you take into account the cost of attendance on steam engines, boilers, price of water, carriage of coal into and ashes out of a central station, and the cost of chimney shaft, setting, and repairs of boilers. But the heaviest loss is in the fuel wasted in getting up steam after several hours' rest of the boilers, and the waste of heat if the fires be banked for 20 hours out of the 24. On the other hand, the gas engine

can be started in a few seconds, and there is no waste in the "hours of idleness." Here, then, we have under our own hands the most effectual and cheap system for immediately supplying fuel when wanted, and restoring it in the frequently recurring intervals.

Having disposed of this difficulty, I come to another obstacle in the way of electric progress—viz., the cost of conductors. As long as overhead high tension conductors were allowed, the difficulty was not so great. But since the Board of Trade nearly always requires underground conductors, the cost has been greatly enhanced, and two systems have been adopted—for the low tension system, bare copper rods laid in concrete culverts; and for both low and high tension, insulated cables, generally drawn through cast iron pipes, which are sometimes filled with oil. Both of these modes are very expensive; and this has led to the transformer system, which is the most important development that has taken place during the last dozen years.

The transformers are of three totally different kinds, as they are to be used by the continuous or alternating current. In the first case, the transformer consists of an electric motor made to revolve by the current; the same axis carrying a dynamo, the revolution of which in a magnetic field generates a current of lower voltage. In the first step, the electricity is converted into motive power, which is again converted back to electricity. The first may be a current of high tension requiring a cheaper conductor; and the secondary current may be of the lower tension used in electric lighting. As in each of these conversions we get out, say, 86 per cent. of what we put in, the result is about .86 × .86, or under 75 per cent. of the originating current, without counting the loss in the primary main. For the low tension system, another plan has been used—viz, four sets of storage cells are charged in series by an originating current of (say) 400 volts, until each set can give a tension of 100 volts. They are then disconnected from the charging mains, and discharged separately through the service mains at 100 volts. The object of the whole arrangement is to diminish the cost of the conductors in the ratio of over 3 to 1; but the heavy loss incurred by storage cells, their great cost and rapid deterioration, are inseparable from this system.

As a motor actuated by an alternating current has not yet come into practical use, another device has to be resorted to, the germ of which, as well as of those of many other inventions, is to be found in Faraday's earliest papers on the subject. Taking a soft-iron ring, he wound on different parts of it two coils of insulated copper wire. On making or breaking a battery current through one of these coils, a momentary current was produced in the other. The alternate current transformer of the present day consists essentially of the same parts—viz, a soft-iron core wound with two coils; one of thin wire through which the original alternating current is carried, and the other of thicker wire through which a current of lower tension is generated fit for electric lighting. A common proportion is 2,000 volts reduced to 110 volts.

Now the only object of all these transformers is to diminish the cost of the conductors from the central station; and the relative cost of conductors depends on this principle. What the electrician sells is a watt; but the watt, like the foot-pound (to 44 of which it is equivalent), is a compound unit, being the product of the volt and the ampere. To secure a given product, we may make one factor very small by making the other very large—1 lb. falling 1,000 feet is the equivalent of 1,000 lbs. falling 1 foot. Now the heating of the conductor, and the dissipation of energy as heat, in no way depends on the volts, but altogether on the amperes being proportional to the square of the amperes, multiplied by the resistance. Small wires offer more resistance than large ones; and to secure a sufficient number of watts through them, we must increase the volts and lessen the amperes, which alone cause the heating and loss of energy. The whole object, therefore, of these systems is to diminish the cost of the conductors; and it seems now to be generally agreed among practical men that it is not economical to send more than 1,000 amperes per square inch as the maximum current that a copper conductor can safely carry—a quantity which at 100 volts would supply about 750 16-candle power lamps. But I find that Mr. Crompton, in his celebrated paper on the relative efficiency of alternate current and battery transformers, allows only 720 amperes per square inch. Mr. Crompton says that a double conductor, each of 1½ square inches section, shall be used for 1,080 amperes. At 110 volts, it requires about 7 amperes for a horse power; so that the 3 inches of copper gives only 154 horse power. It would, therefore, require two sets of these double conductors to deliver as much power as a 6 inch gas main could carry; and the cost, instead of £500 or £600, would now run up to £1,100. If the gas pressure was increased to 16 inches, the corresponding electric conductors would cost £22,000. If the alternate current is employed, the insulated cables would, by Mr. Crompton's calculation, cost 2.63 times as much. Besides this, there would be considerable loss of electricity, and practically none of gas, in a main laid specially for the purpose and not tapped for service pipes.

But this change of tension cannot be effected without loss. My friend, Mr. Mordey, appears to have been very successful with the closed, while Mr. Swinburn advocates the open Hedgehog transformer. What the loss is I would be afraid to say, but it used to be laid down that these transformers had a very high efficiency when on a full load, but showed great loss at low loads. Originally each house was supplied with a separate transformer. Now, I believe, the transformers are "banked," using a large, number, or those of large size, for the heavy hours, and a smaller number for the light hours. I must say I am rather surprised at the high yield claimed for some of them; and I should like to see some reliable return of the number of watts put into the main at the station and the number paid for by the consumer, for this is really the financial question to be settled. Dr Fleming, who has devoted so much time and ability to this subject, estimates the efficiency of both forms open and closed throughout the 24 hours at 75 per cent. At Deptford they only hope for 70 per cent.—representing a truly formidable loss.

Is there any way of getting out of this difficulty about conductors? I allege there is; and again I say the remedy is in *your* hands. Instead of distributing electricity, distribute *gas* to be used in gas engines near the spot where the electricity may be required. When, about a year and a half ago, I began to investigate the question seriously, I was surprised at the great economy of "distribution of energy by gas." Of course, it was only potential energy; and it would have been more correct to speak of the distribution of gaseous fuel.

The editor of the *Electrician* was good enough in October, 1891, to publish a letter of mine on the subject, every statement of which has remained without contradiction. I took as an example a 6-inch gas main, which would not cost more than about £500 or £600 a mile. Such a main would, at a pressure of 4 inches, deliver at a distance of one mile 9,000 cubic feet of gas, which should yield 300 to 400-horse power. I showed that the power necessary to force the given quantity of gas at the given pressure was only one tenth of a horse power. I thus arrived at the result that we can send as much gas as will supply 3,C00 to 4,000 horse power one mile for one horse power, costing ¾d. Of course, by raising the pressure to 16 inches the delivery would be doubled and the power quadrupled; so that we could still send 6,000 horse power one mile for 3d. This I must say is an extraordinary result, especially when you compare it with the efficiency of other modes of transfer of force so clearly explained by Mr. Kapp and Professor Unwin.

Now let us take a glance at hydraulic transmission by a 6 inch main, which, of course, for 750 lbs. pressure must be far more expensive than a gas main which has to bear only ½ lb., or the 1,200th part of that in the hydraulic main. This expensive 6-inch main will carry only 116 horse power, instead of the 600 horse power which the cheaper gas main can convey; and while there is no appreciable loss on the gas main, there is a loss of 20 per cent. on the hydraulic main. The cost per horse power by high-pressure water may on an average be put down at 14d. for small, to 5d. for the largest powers, against ¾d. per horse power for gas.

To revert to the question of storage, I may give Professor Unwin's figures:

The capital cost for storage of one horse power hour is estimated by him as follows—

Gas	£0 5 6
Thermal storage with condensing engines	1 13 0
" " with non-condensing engines	2 5 0
Epstein storage cells	8 0 0
Storage cells at Frankfort	23 0 0

Storage cells Mr. Kapp gives as £30 to £37.

Next with respect to loss in storage—

Gas	0
Storage cells—average	20 per cent.
Transformers, high tension	25 "
Storage battery, transformers	25 "
Thermal storage—not ascertained, but considering loss by radiation, say	20 "

Loss in transmission—

Gas	1
Electricity	10 to 30 per cent.
High pressure—hydraulic	20 "
Low pressure, as at Edinburgh	50 "

It may seem strange to some minds—especially those with municipal

interests—if I make the following statement: I think it is a pity that the electric light was not handed over to those who were already the purveyors of light to the public. I mean the gas manufacturers. In some cases this system has been recommended; but even where gas companies work independently of the corporations, I believe that they could supply the light on better terms than any separate organization. The reasons why I believe this result could be obtained are: (1) There would be no necessity for a second staff of directors, secretaries, engineers, accountants, collectors, etc. (2) In most cases there would be no need to purchase or rent any additional land. (3) A considerable portion of the existing staff of the gas works could manage engines (and even boilers, if such were required) with but little additional cost. (4) The storage can be provided at a very low cost, and so eliminate the great difficulty arising from the great fluctuation of demand between 1 unit and 80 units. (5) If generating stations are placed at a distance from the works, the feeding gas mains cost very little; the power employed for transmission is infinitesimally small; and the loss by leakage practically nothing. (6) The cost of production per unit is very much lower than by any other system. I believe that in most cases gas of low illuminating but good heating power can be produced on the works for 1s. 6d. per 1,000 cubic feet and leave a profit; no outlay having to be incurred for mains, services, and meters—mains being charged as conductors.

As an example of what may be done with even a small plant worked with three 16 horse power nominal gas engines, and using 70 "E.P.S." cells of the "K" type, I quote from actual working returns:

The average of the results for August and October gives the cost of—

Town gas at 3s. 3d. per 1,000 cubic feet as....	1.550d.	per unit.
Labor.....	0.425	"
Oil and waste.....	0.014	"
Water.....	0.033	"
Total.....	2.022d.	per unit.

If, however, heating gas can be made at a profit for 1s. 6d. per 1,000 cubic feet, the first item (cost of gas) would be reduced to 0.71d.; and the whole cost would be only 1.182d., or considerably under 1¼d. per unit, a cost less than is incurred in many cases where water power is employed.

I may add a few examples from Ireland. Electric lighting was started in Waterford some years ago, and the price charged for each arc lamp was £26 per annum (subsequently reduced, I believe, to £23), although the printed statements of the contractors would seem to show that the lights costs £32 each. The consequence was that the snake had bitten the infant, who died a short time since from the effects of slow poisoning; and electric lighting has ceased in Waterford, although the steam engines were described as "beautiful compounds." In our own immediate neighborhood, at Larne, a town of 4,200 inhabitants, works were established by Messrs. Gordon & Co.—a firm which had immediately before declared a dividend of 30 per cent. A short time since, the able head of the firm, Mr. J. E. H. Gordon—a man of great and very varied attainments—lost his life by a melancholy accident. This, I suppose, disorganized the company's business, for the plant, which was said to have cost them £8,000, was offered to the Town Commissioners for £6,000; but the offer was declined—one of that body stating that, at the best, six years would elapse before the concern could pay the working expenses. In Carlow, a town with a steadily declining population of only 9,000 inhabitants, works have been established. The current is generated by water-power four miles distant from the town; but, as far as I can learn, the income of the company could scarcely pay the rent, the upkeep of the plant, and any fair salaries to the officials. English people can hardly understand how small is the number of inhabitants in an Irish country town who can afford to pay for any luxury, or incur any expenditure save what is strictly necessary. If the city of Waterford—an important port, where several lines of railway converge—with a population three times as large as that of Carlow, could not support a central station, I do not see how the latter can be successful. But Killarney, with a population of 5,500, is boldly venturing upon a similar experiment, although the town is a "Sleepy Hollow" amidst beautiful scenery except for a few months in the summer and autumn, when artificial light is not much required.

I had intended to make some observations on the testing of illuminating power, founded on the idea that the producers should get some credit when they give more than the parliamentary standard; and, in fact, be credited with the average within certain limits. The Board of Trade has recognized this reasonable system in the case of gas-meters—allowing a variation of 5 per cent., and something similar in the case of electrical tension, although a difference of one volt may not make a difference of 5 or 6 per cent. in the light. But I have already occupied your time too long. I cannot, however, leave the main subject of this address without expressing my obligations to Mr. Thomas Patrick Travers, Assoc. Inst. C.E., and a member of the Institution of Electrical Engineers, a young engineer of great promise, who has practically studied electricity as well as gas supply. He has pointed out to me many of the facts which I have detailed to you, and has checked my statements. I think it would be well if many of our members would imitate his example, and give attention to the new lighting agent, as I have shown it is so closely connected with our future interests.

It is now more than 10 years since, at the Gas and Electrical Exhibition at the Crystal Palace, you wanted me to express my views. I pointed out that in 1810, as now, the best mode of distribution was by copper wire, and the best wick for the electric lamp was carbon. Sir Humphry Davy had established these facts. But in the generation of electricity from mechanical force, an enormous advance has been made since the time when, over 80 years ago, this "new planet" first "swam into the ken" of the great philosopher; and what is most remarkable is the fact that this marvellous growth was derived from two small laboratory experiments. First of all, Oersted, in 1819, discovered that a magnetic needle suspended on a pointed pivot was deflected if an electric current was passed through a wire in its vicinity, and parallel to it; and thus electricity produced mechanical movement. It seems strange that no one thought of trying the converse—namely, whether moving the magnet mechanically would produce a current in the wire—until 1831, when Faraday made his great discovery that, in a conductor moved into or out of a magnetic field, a momentary current was produced as it crossed what he called the "lines of force." Everything that has been done since then by Siemens, Gramme, Wilde, Wheatstone, Sadd and others, is but the natural growth of the seed that germinated in the fertile soil of Oersted's and Faraday's intelligence. And what a growth it has been! The telegraph, the electric light and traction, and the transference of power for over 100 miles, conversations carried on between two people separated by 1,000 miles, electro-metallurgy, the separation of rare metals from their matrices, and the thousand offices performed by this deft and willing servant of man. When your practical man scoffs at what he calls the toys of science, let him reflect on the momentous issues of these two simple experiments. In the whole history of practical science, nothing is so amazing as the development of dynamo-electric energy. Compare it with the steam engine. Now, nearly a century and a quarter after Watt's great discovery, engineers can convert into power only 10 per cent. of the heat evolved in the boiler furnace; and, in not much more than a decade after the invention of the dynamo, over 90 per cent. of mechanical power had been converted into electricity—a sudden bound from tentative and moderate success to practical perfection. Brilliant as is the fame that irradiates the memory of Watt and his disciples, a far brighter meed of praise is due to Faraday's successors, who in so short a time eclipsed the glories of a century. And this important deduction is to be made, that it is "beyond the wit of man to devise" any system by which a larger yield of electricity can be gathered from a given quantity of mechanical force. The goddess sprung full-armed from the brain of the philosopher.

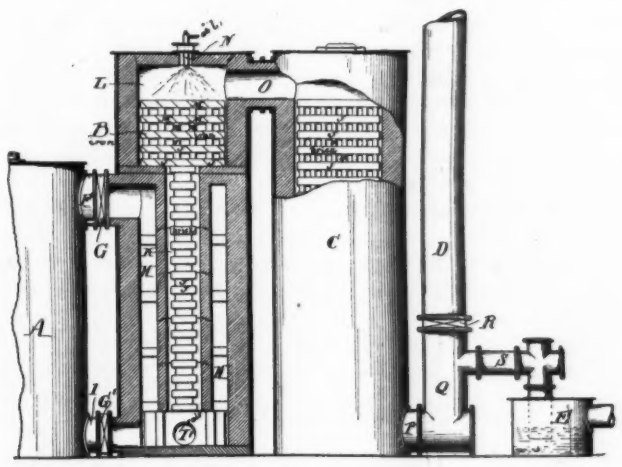
And when we remember the small grain that was sown and the mighty tree under whose branches we gather and find shelter, let us venerate the memory of those who devoted their lives to science, and remember that the observation of minute phenomena may, as the weather-marks in the tree guide the Indian wanderer, lead us into new paths of progress, open out new vistas of thought, carry us into new fields of industry, and, by raising our thoughts from small effects, lead them to contemplate the great causes that surround us and govern our lives. Every new observation enables us to learn something more of these laws of nature which, misapprehended, lead to failure on failure, but which, if rightly understood, may minister to the physical well-being of man, and elevate his mind to those loftier planes of thought where he will stand but little below the highest intelligence. As he rises from level to level, his horizon widens, and each generation gathers a broader view of the vast expanse which nature spreads before it with all the variety and beauty of a garden and the grandeur of a woodland, interspersed with the sheen of many a sunlit lake, and the sober shadows of alleys sheltered beneath the lush verdure of overhanging arches of the primeval forest.

The Collins Carburetor.

On May 23, 1893, U. S. Letters Patent (No. 497,866) were granted to Mr. Charles Russell Collins—the inventor subsequently assigned the patent to the United Gas Improvement Company—for a device for carbureting water gas. Using the words of the specification:

The invention relates to the construction of carburetors such as are used in water gas plants for enriching the water gas, and the object is to provide a carburetor of efficient and durable construction. This is accomplished by means of the devices hereinafter described in connection with the drawings, which show the carburetor in central vertical section, together with other parts of the gas making apparatus.

In the drawing *A* represents a gas generator, *B* the carburetor, *C* a



fixing chamber, *D* the stack, *E* the washer for the gas. All these parts except the carburetor are of familiar construction and need not be further described, save to point out that a conduit *F* having a valve at *G* leads from the generator into an annular chamber *H* formed in the carburetor *B* around an interior chamber *K*, open at the bottom and top as shown, and filled with checkerwork *J* of the ordinary kind—that is, of brick.

I is a conduit opening into the bottom of the carburetor and leading from the generator, the conduit *F* being preferably used for the producer gas formed in blowing up, and the conduits *I* and *F* at will for the water gas.

G and *G'* indicate valves in conduits *F* and *I*, and *I'* is an air blast opening.

At the top of the chamber *K* is an enlarged chamber *L*, also filled with checkerwork, as shown at *J* and *M*, the upper layer *M* being of iron, and the depth of the iron checkerwork being such as will insure that no fluid oil will pass beyond it (in the construction shown below it) and come in contact with the brick checkerwork. This forms an important feature of the invention, and makes the carburetor much more durable, as the oil when it comes in direct contact with the brickwork has a disintegrating effect and rapidly destroys it.

N is the oil injector situated next to the iron checkerwork, *O* a conduit leading into the fixing chamber *C*, also filled with checkerwork. *P* a conduit leading to the washer *E* through the pipe *S*, or to the stack *Q*, which is provided with a valve indicated at *R*.

In practice the generator is blown up, the valve *G'* being closed, the gases passing through conduit *F* into annular passage *H* serving to heat the walls of chamber *K*, and then being mixed with air from *I'* and ignited, pass up through chambers *K*, *L*, conduit *O*, chamber *C*, conduit *P* and stack *Q* to the atmosphere. When water gas is being made valve *G* is closed and *G'* opened, or *G'* closed and *G* opened, as may be desired, and the gas enters the carburetor through conduits *I* or *F*, passing up through the heated checkerwork in chambers *K* and *L*, and the injector *N* at the same time throws a spray of oil down on the iron checkerwork, which serves to vaporize it, together with the action of the hot gas. The vapor and gas pass together to the fixing chamber *C*, and thence to the washer, the valve *R* being closed.

The advantage of the spiral construction of the carburetor with respect to the chambers *H* and *K* is not only that the entering gas serves to heat the interior chamber, but also that the gas conduit *F* can be and is made very short, and very little heat lost by radiation.

The claims made are:

1. In a carburetor the combination with the shell of a carburetor an oil injector and a checkerwork filling consisting of a portion *M* formed of iron and situated in that part of the casing where the oil enters, and a portion *J* formed of brick situated at a distance from the oil entrance, substantially as specified, and whereby the brick checkerwork is preserved from the destructive action of the oil.

2. A carburetor *B* having in combination a central chamber *K* filled with checkerwork, an annular gas passage *H* formed around said chamber, a broadened chamber *L* situated above the chamber *K*, and also filled with checkerwork, and an oil injector *N* at the top of chamber *L*.

Electricity as a Fire Hazard.

By Mr. C. J. H. Woodbury.

Electricity in the form of lightning undoubtedly constituted the first fire hazard—which has continued to this day—but it is proposed to limit this paper to a consideration of the fire hazards from electricity in the service of mankind. With electric lighting apparatus it was found at an early day that the hazard was largely dependent upon methods of installation, and not, therefore, absolutely an inherent danger inseparable from its use. In order, therefore, to determine these conditions, it was necessary to provide inspections made by those familiar with electricity, but not necessarily acquainted with other matters of fire hazard and its defense already known to underwriters. This introduced the thin of the wedge, forcing the technical man into insurance practice.

It was not that the necessity of a knowledge of the wide range of conditions comprising the fire hazard was not fully appreciated, but that such experience had not been applied in connection with the practice of underwriting on a sliding scale.

The applications of electricity previous to its use for lighting and power were not considered to form a hazard. On the contrary, its use in connection with the municipal fire alarms has been of the highest value, and, indeed, essential to that prompt service of the fire department which is the salvation of American cities, built with careful reference to every feature entering into their conditions save the fire hazard.

None of the apparatus for the transmission of signals was a cause of fire, and the wires were not sufficiently numerous to be considered obstructive until the introduction of the telephone increased their numbers to such an extent that they almost shaded the sun, like the arrows of the Persian army.

When these telephone or telegraph wires come in contact with electric lighting wires, heavy currents are conducted by them and imposed upon apparatus which is of insufficient conductivity, and the electricity is converted into heat sufficient to cause fire. In this matter the march of invention has proved equal to the necessities of the case, and, although the result has been reached by dearly bought lessons, the problem has been solved by the telephone interests in devices for the protection of their instruments against the various classes of foreign currents liable to be imposed upon them.

The protective apparatus is fourfold in its nature. Lightning is averted by lightning arresters; incandescent lighting currents by fusible wires in glass tubes or by tinfoil wrapped with asbestos paper; arc lighting or power currents of great pressure are turned in other directions by air cut outs, and finally intermittent currents through high resistance and of volume too great for the apparatus, known as "sneak" currents, are shunted by a ball of bayberry wax pressed against the coils of an electromagnet in the apparatus by a spring switch, and when the magnet becomes warm by abnormal currents the ball softens and causes the currents to be switched out of circuit.

Electric wires serve as a defense against lightning by presenting such an inductive action upon the electrical condition in the clouds as to reduce the difference between the earth and the clouds, and therefore to diminish the violence of the electrical discharges constituting lightning. It is this defense by the wires which has reduced the losses by lightning strokes in cities during recent years.

Most of the so called strokes of lightning on telephone and telegraph instruments are not the direct lightning strokes, but are inductive currents of far less potency, which, by their greater number, diminish the violence of the direct stroke which follows.

The overhead wires are, however, a serious hindrance to the operations of the fire department, and will continue to be so until a fully practicable system of underground wires performs the same service, for one system will not be substituted for the other save under this condition.

The telephone companies are placing the wires underground to the greatest extent possible under existing conditions, but the overhead wires for the street railways appear to be a necessity until the public service for the transportation of large numbers of people in cities with the same rapidity and promptness, and with assured operation in all weathers and under all conditions can be performed by some other application of electricity in a satisfactory manner.

Underground wires are not, of necessity, safer than those overhead, for the contact with the earth increases the danger wherever the insulation becomes insufficient from any cause, and there is no leak so persistent and elusive as an electrical leakage.

The principal dangers from underground wires are: First, diverting the electricity by earth connections through conductors of combustible material and high resistance, such as buildings, thus causing fires; second, the currents of electricity dissociating water by electrolysis into its

two gases, and then igniting this explosive mixture by an arc; third, the earth return currents used in trolley street railway service have impaired water mains by electrolytic action, and indeed such currents have destroyed the insulation on other underground wires, whose insulating covering was surrounded with metallic tubing.

In the uses of electricity there is a wide distinction to be made as to whether the electricity is generated on the premises or whether it comes a long distance from a central station. In the former case the apparatus is designed for the service to be required from it, and the wires are not exposed to lightning. In the latter case there is the exposure to lightning and the liability to excessive electrical conditions both as to current and pressure.

Experience is showing that for a system of illumination electricity can be made fully as safe as any other method. The improvements in the methods of installation of such apparatus can be ascribed to the improved insulating materials and fixtures, as well as to more efficient means for regulating the electrical apparatus rather than to any new realization of the results desired many years ago.

It is assumed that this is not the place for the details of underwriters' rules, which have proven so efficient in establishing conditions of safety in the transmission of electricity for lighting and power. In a few words the essentials of safety can be said to include the necessity of preventing arc lights from scattering sparks, confining the electricity to its metallic circuits, furnishing conductors of ample capacity, protecting the apparatus by properly arranged safety fuses, and arranging the switches so that they shall not cause dangerous arcs.

The depreciation of much of the apparatus in use must in time become a serious question, especially with the earlier installations, where both methods and material are far below the present standards.

Electricity is in the position of an essential adjunct to the world's work in manufacturing and in illumination, and the use of these wires, conveying vast amounts of energy which can be converted from its legitimate service in illumination or power into a torch of destruction, is increasing with such rapidity that it is in this field that the work of the underwriter must keep pace with the advance of constructive invention by the exercise of equally defensive methods.

The Pittsburgh Gas Engine.

It is not necessary in this article to discuss the advantages and disadvantages of the several types of gas engines now on the market, or to dwell upon the theoretical questions involved, as these points have been repeatedly presented in technical papers and are comparatively well known. In designing the Pittsburgh gas engine the aim of Albert Schmid, Superintendent of the Westinghouse Electric and Manufacturing Company, and of Mr. Bechfeld, was to produce an engiue possessing the following characteristics: Close regulation under the widest variations of load; an admission device that would admit gas in quantities exactly proportioned to the power required; an ignition device that would be absolutely positive and efficient in its action; to provide complete jacketing and thorough lubrication; and to be compact and simple in its general design and to have all parts easily accessible. It is evident that an engine having these features will be economical in the highest degree.

The engine here illustrated is made by the Fuel Gas and Manufacturing Company, of Pittsburgh, Pa., in sizes from ¼ up to 200 brake horse power. As the principles of design and operation are the same for all these engines, a brief description of a single example will embody the characteristics of the whole class. The most striking innovation is found in the use of a crank chamber to inclose the bearings and lower end of the cylinders. This chamber is filled almost up to the shaft with a mixture of oil and water, into which the crank shaft and connecting rods splash at every revolution, so as to completely deluge the bearings, piston and interior of the cylinders, thereby not only affording copious self-lubrication, but also supplying an efficient jacket to the piston. Oil for the crank chamber is introduced through the main bearings, which are supplied from the only two oil cups on the entire engine. A simple pipe connection with a city main supplies the necessary water. Another pipe, serving to carry off the overflow, is made, by means of a funnel head, to indicate the level of the lubricants in the crank chamber.

All the Pittsburgh gas engines are built with two cylinders on a single shaft, and, as usual, abnormal heating is obviated by the employment of water jackets. Each revolution made by the engine operates valves admitting the gaseous fuel alternately to the one or the other cylinder. As the period of admission is controlled by positive action, the crank shaft receives an impulse once each revolution, no matter what the load, but the energy of that impulse is predetermined by an independent piston valve. In order that the maximum amount of energy may be developed by the explosion of the gaseous fuel, there is but one value that the relative amount of gas and air can bear to each other. This value has been determined by a prolonged series of chemical analyses, and the Company now design their measuring piston valve so that it shall always admit gas and air in their correct proportion for producing the correct maximum result, but at the same time vary the total amount of mixture directly as the work of the individual piston stroke.

By reason of this nicety of adjustment of the energy developed to the momentary load, and by the constant use of fuel at its maximum efficiency, this engine is enabled to develop the maximum amount of work for each unit of gas used. Furthermore, as the shaft receives, once every revolution, an impulse that is proportioned to its load, a smooth and regular speed is maintained.

The governor regulates the speed and controls the admission of gas to the cylinders. It is mounted upon the shaft, between the cranks, and, by direct connection between the eccentric rod and valve stem, insures an accurate and positive travel to the measuring slide valve.

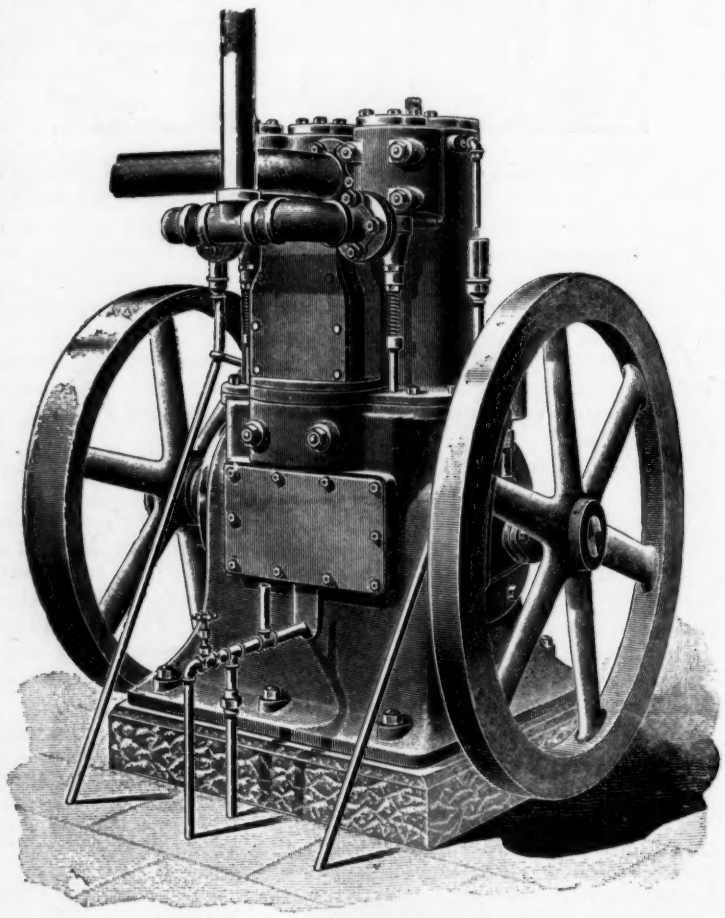


Fig. 1.—The Pittsburgh Gas Engine.

The igniter employed is of the electric spark type. It consists, in brief, of an arm operated by a cam. At just the proper moment the arm is made to break an electric circuit, and the arc thus formed—intensified by the use of an induction coil—ignites the fuel instantly. As the arm is actuated by a positive motion, there can be no failure to produce a spark and no failure in the resulting ignition of the fuel. In order that the engine may be entirely self contained, the electric current is supplied from a galvanic cell. If preferred, however, the requisite energy may be taken from a dynamo circuit.

The following is the report of a test made by competent and disinterested engineers of one of these engines, rated at 9 nominal brake horse power, having an 11 inch stroke and pistons 6 inches in diameter. As will be noticed, contrary to the usual practice, the Company rate their engines by the brake and not by the indicated horse power—*i. e.*, by the energy obtainable at the band wheel, which is the only work of any engine available for the buyer.

The test was made using city illuminating gas as a fuel. This is more expensive than common fuel gas, which nowadays is quite generally supplied through city mains or may be economically manufactured even on a small scale; but the Company preferred to fulfill all the most exacting conditions, in order that any individual might decide for him-

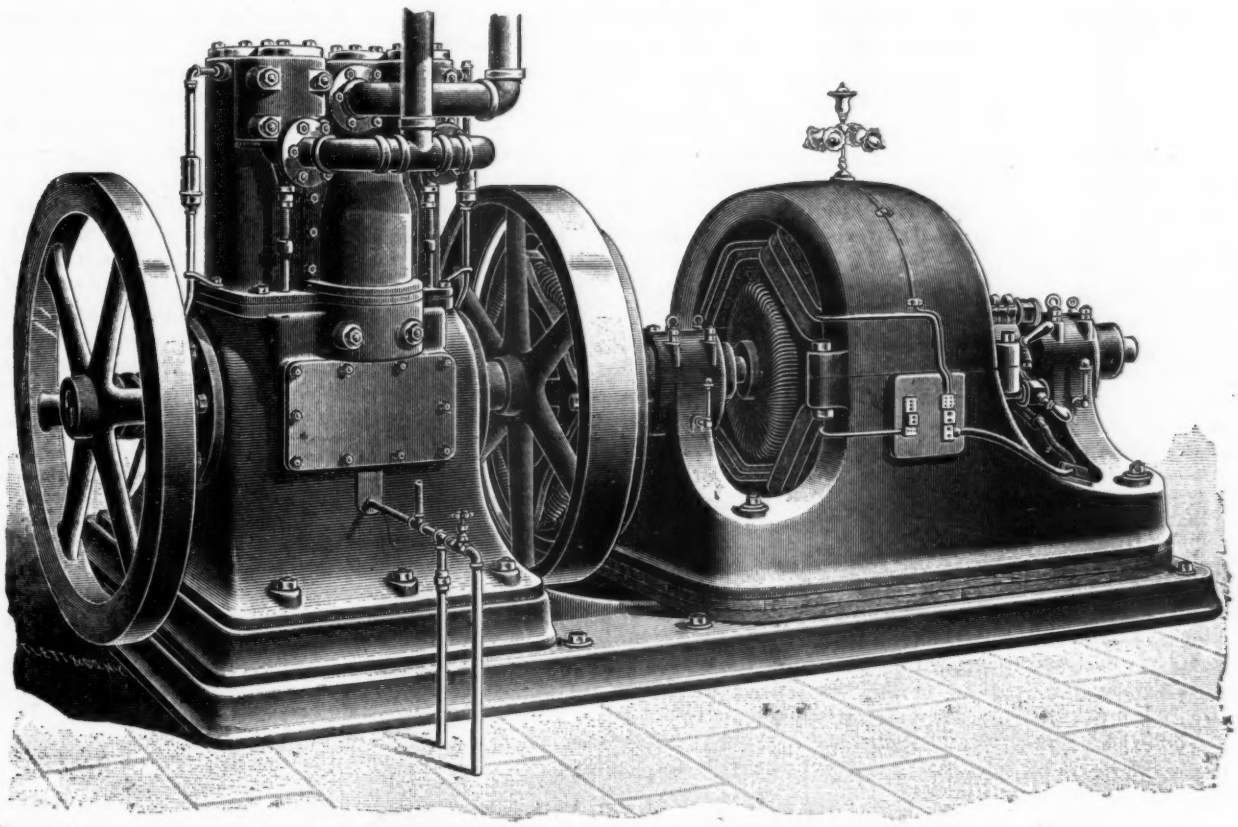


Fig. 2.—Pittsburgh Gas Engine Coupled Direct to Dynamo.

self whether or not their engine was available for his own special conditions.

The gas meter employed was a standard one, manufactured by the Fuel Gas and Manufacturing Company, and guaranteed correct within 1 per cent. The springs for indicator work were carefully tested, and the results corrected for any small error. The indicators were placed directly upon the cylinder cases. For measuring the delivered horse power a Prony brake was used, having a wheel 27⅝ inches in diameter, and an arm 29 1/16 inches in length. The indicated horse power was calculated in the usual way—*i. e*, from the number of revolutions and effective pressure.

The duration of each of the three runs made, A, B, C, was two hours.

		A	B	C
Load		Full	⅞	0
Load on brake in pounds		75.8	52.6	0
Revolutions per minute		223.5	223	221
Pressure in Pounds per Square Inch in Cylinders.				
	Cylinder.			
Mean initial	I	159	103	27.4
	II	161	104	28
Mean terminal	I	25	18.8	8.8
	II	25.3	19	9
Mean effective	I	61	47	17
	II	61.5	47.2	17.1
Indicated Horse Power.				
Cylinder I		5.38	3.59	0.80
Cylinder II		5.40	3.62	0.82
Total		10.78	7.21	1.62
Brake horse power		9.10	5.80	
Horse power loss in friction		1.68	1.41	
Mechanical efficiency	per cent.	84	80	
Gas.				
Temperature, degrees, C		22	16	15
Pressure in inches		1.5	2	2
Amount in cubic feet, at 0° consumed per hour		165	121.8	50
Amount in cubic feet, at 0° consumed per hour per 1 horse power		15.3	10.9	30.8
Amount in cubic feet, at 0° consumed per hour per B horse power		13.2	21	
Water Jacket.				
Pounds of water used per hour		1,538	1,210	1,009
Rise in temperature, degrees, C		220.2	19	17.8

Samples of both the supply and the exhaust gases were sent to the Pittsburgh Testing Laboratory, to be analyzed. From the results of the analysis reported by that firm, it was found that a cubic foot of the gas used in the test will, if completely burned, yield 434.3 B. T. U. of heat. Though this is a very low value per cubic foot, it only indicates that the Pittsburgh gas is a much better illuminant than fuel, and does not in any sense favor the gas engine; on the contrary, it rather reduces the efficiency by the unavoidable heating of superfluous air.

With the conditions of the test as given, the energy received and expended per hour was divided as follows:

Total energy received in foot pounds	55,200,000	40,800,000	16,750,000
Total energy expended—			
Indicated work in foot pounds	21,280,000	14,360,000	3,200,000
Water jacket in foot pounds	23,900,000	17,800,000	1,382,000
Exhaust, radiation, etc., in foot pounds	10,020,000	3,740,000	12,168,000
Efficiency for 1 horse power	39 per ct.	35 per ct.	19 per ct.
Efficiency for B horse power	33 per ct.	28 per ct.	....

The Enrichment of Coal Gas.

[A Paper read by Prof. Vivian B. Lewes, at the Thirtieth Annual General Meeting of the Gas Institute.]

The question of enrichment is at the present moment of such importance in the minds of the gas managers of the country, that no apology is needed for bringing forward a paper which may be expected to give rise to ample discussion, even if it serves no more useful purpose.

Within the past year, two new processes have been experimentally perfected, which may be expected, from the results obtained, to have a not unimportant bearing upon this question; and as I have had the opportunity of thoroughly investigating them, I think my results and conclusions may be of interest. Mr. William Young, of Peebles, has brought the knowledge which he obtained in the distillation of shale oils to bear upon their further conversion into illuminating gas; and, in conjunction with Mr. Bell, he has erected and worked at the Peebles Gas Works, an apparatus which, from its simplicity and the high results obtained, has attracted a large amount of attention, whilst installations on a far larger scale are already commencing work, and will shortly place the future of the process beyond doubt. The main idea underlying this process is to retort the oil at a temperature of about 900° to 950° C.; and, instead of condensing the vapors (which escape being broken up into permanent gases) in the usual way, to wash them out

from the gas by means of the oil which is afterwards to undergo decom position in the retort. By doing this, nothing but permanent gases leave the apparatus; the surplus carbon present in the oil being left as a deposit of dense coke in the retort. There is no doubt but that very considerable quantities of the olefine and other fixed gases are also absorbed by the oil; but as these are again driven out by the action of heat during the retorting, but little loss takes place. The installation at Peebles consists of two cast-iron retorts, about 10 feet in length, set so as to incline downwards to the far end. They are fitted with doors and ascension pipes in the usual way; but in each door there is a small petcock, by opening which the color of the gas can be seen. This should be of the palest lemon; as it is found that, if any darker color or approach to brown is produced, decomposition of tar and other troubles commence. The oil to be cracked is admitted through small cocks about two feet up the ascension pipe; and it falls down through the ascending gas on to steel plates, which extend 3 feet into the retort in order, as far as possible, to prevent the direct impact of the oil with the iron retort. This, however, has been found to be unnecessary, and has been omitted in the latest installation. The retorts are heated to about 900° C.

As the gas leaves the retort, it passes up the ascension pipes which lead above the bed of retorts to the hydraulic main (situated at the back of the bench), and through a coil of horizontal condensing pipes, to the scrubber, which is of the well-known Young pattern, and made in four compartments. The oil-cistern is situated on the top of the scrubber; and the supply-pipe from it is so arranged that the oil can be made to flow into any one or all of the sections. Having passed through the scrubber, the oil flows back along the bottom of the horizontal condensers, in an opposite direction to that in which the gas is passing, and into the hydraulic main. From the hydraulic main, it passes through a seal into a small cistern containing a float, which is in connection with an indicator close by the oil-feed taps in the front of the working-bench; so that, if the oil is either flowing faster than it is being decomposed or is not flowing sufficiently fast, the supply of oil from the cistern can be regulated so as to keep the balance constant.

The oil used is what is technically known as "blue oil," and has the specific gravity on an average of about .850. Each retort will make 500 cubic feet of gas per hour; and 5½ cwt. of a very dense form of graphitic coke is deposited in the retort for each ton of oil decomposed. This coke collects almost entirely near the back of the retort; and, shrinking from it, it can be readily removed. The coke forms with a practically horizontal surface, which suggests that it has either flowed to the back of the retort in the condition of pitch, and has been carbonized there, or else that the oil has washed it back from the front of the retort and ascension-pipes. The cost of the plant is low; and the installation, which is fitted at Galashiels—and which is considered sufficiently large to make 120,000 cubic feet of gas per day, though 60,000 cubic feet only will probably be wanted—has cost a little over £1,000. The working for several months at Peebles gives an average of 85 cubic feet of gas per gallon of oil; and, although when this gas is tested on an open-bar photometer with a "No. 000" flat-flame burner, it only tests up to from 50 to 60 candle power, and yet when used to enrich 18 candle gas made at Peebles from splint coal, it works out on the enrichment figures to 90-candle power, and sometimes more. This discrepancy is due to the fact that the smallest burners are required to burn so rich a gas without smoking; and as soon as the flame falls below a certain size, the cooling power of the burner exercises so great an influence on the light emitted by the flame, that it is impossible to develop the true illuminating value of the gas. Taking the enrichment figures as the true value of the gas, we have 85 feet of 90-candle gas, or 1,530 candles per gallon of oil.

These figures are so remarkable that it will be of interest to give a brief summary of the results of the analyses which I have made of the products; and by their aid to trace the various actions taking place during the decomposition of the oil. On analyzing the gas, it was found to consist of—

Hydrogen	16.85
Unsaturated hydrocarbons	44.83
Ethane	17.30
Methane	19.00
Carbon monoxide	0.00
Carbon dioxide	0.63
Oxygen	0.24
Nitrogen	1.15
	100.00

Together with a distinct trace of sulphureted hydrogen derived from the sulphur in the shale oil. On withdrawing samples of the oil circulating in the apparatus, it was found to be highly charged with naphthaline, and to contain only small traces of hydrocarbons with low boiling points; but the oil from the trays in the scrubber consisted of the original oil highly charged with benzene and light saturated and unsaturated hydrocarbons, boiling between 65° and 140° C.—chiefly hexane, heptane, nonane, hexylene and heptylene.

These data point to the fact that in the retort the shale oil decomposes in the usual way, yielding saturated and unsaturated hydrocarbons—some gaseous, and some vapors of volatile liquids. The contact with the hot sides of the retort causes the splitting up of some of the ethylene into ethane, methane and acetylene; and the latter at once polymerizes into benzene, and still further into naphthaline. Leaving the retort and passing through the condensing coil, the oil dissolves out all the naphthaline from the gas; whilst in the trays of the scrubber, the close contact with fresh oil removes the vapors of benzene and anything else which could afterwards undergo condensation. It is this which makes the Young gas so permanent. The coke which remains in the retort gives on analysis—

Carbon	98.62
Hydrogen	0.35
Sulphur	0.38
Oxygen, etc. } Nitrogen, {	0.46
Ash	0.19
	100.00

The extreme density, hardness and low sulphur will make this coke of value for metallurgical work.

In approaching the question of cost of enrichment with such a gas, we must remember that it is entirely dependent upon the locality of the works, which will to a great extent govern the cost of the oil. The blue shale oil which is at present being used at Peebles can be obtained there at about 2d. a gallon, and the supply will probably be sufficient for the comparatively small installations now being erected. But should the process come into anything approaching general use, it will be impossible to obtain any very great quantity of shale oil at this price. It will then be necessary to revert to Russian oil; and it will not be safe to reckon on a large supply at less than 3½d. per gallon, except in a few favored localities where it can be shipped alongside. Taking the yield of gas at 85 cubic feet of gas per gallon, it will require, roughly, 11¾ gallons to yield 1,000 cubic feet; and this amount of oil can be decomposed in one retort in two hours. The fuel used, however, is not very large, as a good deal of the heat from the ordinary benches can be utilized. A fair calculation of the actual cost would be 4s. 2d. per 1,000 cubic feet.

The second process which I wish to bring to your notice is one for which I am responsible, and which is the result of attempts I have made to get over some of the drawbacks to be found in the ordinary carbureted water gas processes. Through the kindness of Mr. A. F. Wilson, I have had the opportunity of using some spare plant at the gas works at Aldershot; and after nearly two years' experimenting, I think, have succeeded in making a carbureted gas which in composition and properties will more nearly approach a rich coal gas than any which has been proposed. Mr. Young's admirable process is one for enrichment pure and simple; but there are many works where space is an important factor, and where it would be difficult to provide room for a bench of oil gas retorts, whilst many managers would be glad to increase their power of daily production, and also have an ally which would enable them to produce gas with great rapidity in case of fog or labor troubles. It is to this latter class that the carbureted water gas plant, and my modification of it, will appeal as an enrichment process.

I need not here describe the various water gas processes which have attempted to gain a foothold in England. It will be sufficient to say that the only one which has been commercially successful is the "Improved Lowe," by means of which several million cubic feet of gas are daily made at Beckton and supplied mixed with coal gas to the London consumers. The only objection I have to raise to this process is that the purified gas contains about 30 per cent. of the highly poisonous carbon monoxide, and also that the method of decomposing the oil which is used does not yield as high a result as can be otherwise obtained. The result of the Beckton working gives the cost of 25-candle gas as (roughly) 2s. per 1,000 feet.

In attempting to improve upon this process, I have aimed at reducing the quantity of carbon monoxide in the gas, and increasing the hydrogen—at the same time retaining the rapidity of make which gives carbureted water gas so great a charm, and also doing away with the large external superheaters which are so expensive and troublesome an item

in the Lowe apparatus. In order to do this, I constructed a vessel of ¼-inch plates, lined with firebrick, and divided internally into three compartments; the two end ones being filled with small pigs of iron, and the center chamber with fuel. Coke in the center chamber is raised to incandescence by an air blast; and the producer gas so formed (and which consists of a mixture of carbon monoxide and nitrogen) is led down through the two side chambers containing the iron. By the time the fuel has been raised to the right temperature, the iron has also become red hot, partly by the heat passing through the division walls which separate it from the fuel, and partly by the impact of the hot producer gas. The air blast is then cut off and superheated steam injected at the bottom of the iron chambers. Passing over the metallic surface this steam is broken up, with liberation of hydrogen; the iron taking up the oxygen of the steam and becoming converted into oxide. While this production of hydrogen is going on, oil is being injected in a fine spray, by means of superheated steam, into the center of the incandescent fuel. The steam attacks the fuel, giving rise to a mixture of carbon monoxide and hydrogen, which dilutes and protects the oil that is being decomposed by the heat into permanent gases; any carbon which is deposited being left in the fuel, and being utilized there during the next process of blowing up. Superheated steam is also injected at the bottom of the fuel chamber, and this gives rise to a brisk uprush of water gas, which rapidly washes the oil gas made in the upper part of the chamber out of the incandescent fuel, and so prevents the hydrocarbons from being decomposed to too great an extent.

In several forms of water gas apparatus, attempts have been made to introduce the oil into the fuel, and so to utilize the heat of the fuel chamber in decomposing the oil. But these attempts have all been failures, from the fact that the oil has simply been allowed to flow in, and the high temperature has entirely burnt it up, producing practically nothing but carbon and hydrogen. The injection of the oil by steam, however, prevents this taking place, as the steam will always attack the fuel rather than the oil, on account of its high temperature. The water gas produced forms a protecting envelope, which shields the gases produced from over-decomposition, and allows them to escape into the top of the generator, where they mingle with the hydrogen made in the side chambers, and pass away to the hydraulic mains and condensers. As soon as the temperature has fallen to the point at which carbon dioxide begins to appear in any quantity in the gas, the making is stopped, and the generator fuel is once more raised to incandescence by the air blast. The producer gas is then led, as before, down through the iron chambers, and reduces the oxide of iron formed there during the making of the hydrogen back to metallic iron, at the same time raising its temperature to the point necessary for again making gas. In practice I have found that from 5 to 6 minutes is as long as it is advisable to make the gas, as by that time the carbon dioxide has gone up to about 3 per cent., and any prolongation of the run would rapidly increase this proportion and entail extra expense in the purification.

It will be seen from this brief description of the plant that the gas is practically a mixture of oil gas, water gas and hydrogen; and the result of working in this way is to reduce the carbon monoxide from 30 to 15 per cent., which I conceive to be a safe limit, even if the gas were sent out alone, without admixture, as would generally be the case with coal gas. I find that the Russian "Solar Distillate" oil, which is the kind used at Beckton in the Lowe plant, answers perfectly well; but I can also use any oil which is sufficiently liquid to flow from the tank containing it to the injectors. The crude oils which it would be impossible to use in any other form of plant can, therefore, perfectly well be used in this; as the carbon and pitchy matters deposited by them, and which would choke any ordinary form of superheater, are left behind in the fuel, and afterwards burnt up there. Experience has also shown that there are practically no residuals from the process, and, like the Young apparatus, it yields gas and carbon only. The average working for several months at Aldershot gives 1,000 cubic feet of 20-candle gas for a consumption of 3 gallons of Russian "Solar Distillate" oil and 35 lbs. of coke, the composition of the gas being—

Hydrogen	40.77
Saturated hydrocarbons, methane, etc	29.20
Unsaturated hydrocarbons, ethylene, etc	14.21
Carbon monoxide	15.15
Oxygen	0.13
Nitrogen	0.54
	100.00

These figures work out 1,333 candles per gallon. But on many occasions we have made 22-candle gas with 2.7 gallons, which means over 1,600 candles per gallon; and as the apparatus used has been of the roughest description, and only worked intermittently, I am in hopes that the large generator I am erecting at the South Metropolitan Gas Works will, when working continuously and at even temperatures, give the higher figure. An apparatus to make 250,000 cubic feet per 24 hours only occupies a space of 18 feet by 8 feet and 10 feet high; so that no exception can be taken to it on the ground of size. The cost of the gas may be reckoned as follows, taking the oil, as before, at 3½d. per gallon:

Oil, 3 gallons, at 3½d	0s.	10½d.
Coke, 35 lbs	0	2
Labor	0	1½
Charge on plant	0	0½
Purification	0	0½
	1s.	2½d.

We can now compare the cost of enrichment by the Young and by this process. We will take the case of a gas manager who can make 15 candle gas by the use of Durham coal, and put it in the holder at 1s. per 1,000 cubic feet, but who has to send it out at 17.5 candle power, in order to ensure its testing above the 16 candle standard over a big district. In this example, 1,000 cubic feet of 17.5-candle gas equals 3,500 candles; and to obtain this he could mix 33.3 cubic feet of the Young gas with 966.6 feet of his 15 candle gas, the mixture costing him 13.33d. per 1,000 feet. On the other hand, he might mix 1,000 cubic feet of his 15-candle gas with 1,000 cubic feet of the 20-candle gas, which would give him the 17.5 candle gas at 13.25d. per 1,000 feet.

It will be seen from these figures that the cost of enrichment for the 2½ candles needed is practically 1½d. in each case—a figure which will compare favorably for enrichment either with cannel or the Maxim-Clark process; and in considering which it would be most advantageous to adopt, the gas manager must be entirely governed by the cost of his original gas and the space at his disposal, as directly the cost of the coal gas rises above 1s., it becomes too expensive to use as a diluent for enriching by the oil gas, and enrichment by carbureted hydrogen at once begins to show a distinct advantage. For instance, if the 15 candle coal gas cost 1s. 2d. in the holder, the enrichment by oil gas would still cost 1½d.; whilst enrichment by carbureted hydrogen would have fallen to ½d. So that the great field for enrichment by the Young process would appear to be in Scotland and the North of England, where the shale oil can (at any rate at present) be obtained cheaply; whilst I hope it will be found that in the South, and those districts where the carriage of coal has raised the initial cost of the gas, that carbureted hydrogen will prove a welcome means of enrichment and even in case of necessity of production.

The cost of erection is small. A generator to make 250,000 feet a day only costing £450. The specific gravity of the gas is almost identical with that of coal gas; so that our knowledge of the rate of flow through mains and meters, and the kind of burners which are best to use, will remain unaltered.

In using the Young gas as an enricher, special precautions will have to be taken to ensure perfect admixture with the gas to be enriched. The richness of the gas means that it has a very high specific gravity; and although theoretically diffusion should make it possible to produce a perfect mixture of light and heavy gases in a holder, yet in practice every gas manager knows the tendency which variations in specific gravity have to bring about "layering" in the holder, and to cause considerable variations in the quality of the gas sent out. But I should imagine that if the oil gas was to be mixed with the coal gas at the right rate of flow for enrichment, at a point between the scrubbers and purifiers, the passage through the latter would largely help in bringing about the desired result.

In this paper I have done my best to entirely divest my mind of any feeling in favor of either process, and present these remarks to you as an interesting chapter in the history of enrichment. In a paper which I had the honor of reading before the Incorporated Institution of Gas Engineers last year, I was forced by the strength of experimental data to a conclusion that no method of retorting oil alone could compete with processes in which the oil was decomposed in a current of inert gas. Mr. Young's admirable process, therefore, came as a most interesting surprise; as his enrichment figures show an enormous advance over anything yet produced by the Lowe or any other well-established process. The fact that in intermittent working with my process I have found it to give figures practically identical with those obtained by Mr. Young, also leads me to suppose that we are still far from obtaining the maximum amount of light possible from the oil. There is no doubt that in the Young process the formation of naphthaline and other hydrocarbons of the aromatic series, point to a loss of illuminating value due

to prolonged contact with the heated sides of the retort; and it must be borne in mind that, although it may be possible to prevent the formation of benzine and naphthaline, yet that when once formed it is not possible to again break them up into permanent gases which have anything in any way approaching the illuminating value of the ethylene from which they were formed. In the same way I am quite convinced that, although my method of cracking the oils gives a higher value from them than any other rapid gas making process, yet that there must of necessity be a considerable loss from the rough treatment to which they are subjected; and although the two processes I have to-day brought before you seem to me far the best at present existing, I also feel that the ultimate goal at which we all must aim is not at present reached.

[Prepared for the *Engineering Magazine* by Mr. S. S. GORBY, Indiana State Geologist.]

Limits of the Natural Gas Supply.

Matter is known to occur in three forms—solid, fluid and gaseous. Gas is matter in the most extreme state of tenuity known to man. Of the various kinds of gas, some are heavier and some lighter than air. By nature's processes matter is changed from the solid to the fluid or gaseous state, and vice versa. The process of changing matter from a solid to a gaseous state is one of decomposition. The change from a gaseous to a solid condition is the result of a combination of elements. All gases with which men are familiar, excepting, of course, common air, are the result of the decomposition of solid or fluid matter. In a commercial sense there are two kinds of gas, natural and artificial. Artificial gas is that produced by methods in which the decomposition of matter is hastened by the artifices of man. Natural gas is that in which the accident of position has led to its production by the decomposition of matter in obedience to natural laws. The substances from which gas is derived are the same in both instances. Technically speaking, all gas is natural gas. With reference to artificial gas, man's knowledge of natural processes enables him to place the gas producing material in such a position as to hasten decomposition, and he applies the husbanded product to his own use. By artificial means the process of gas generation is hastened, but the product derived is the result of the operation of the same laws that operated in producing the stored gas of the widely known fields of Indiana, Ohio and Pennsylvania.

With reference to the substance commercially spoken of as natural gas, and understanding that it is a product of decomposed matter, the next thing is to determine the kind of matter from which it is derived. Matter is of two kinds, organic and inorganic. The natural gas of commerce is confined in various kinds of rocks, which are inorganic. The presumption is that this gas originated in the rocks that confine it. If the gas originated in the rocks that now confine it, it must be the result of chemical changes that have taken place in the rocks themselves since their deposition. Without geological evidence the presumption would be strong that the gas is of inorganic origin, as some maintain; but geological investigations have disclosed that the rocks that form the various gas reservoirs contained, at a very remote period, vast quantities of organic matter, both animal and vegetable. This organic matter was deposited with the sediment in ancient sea bottoms, just as vast quantities of organic matter are being deposited to day in the mud at the bottom of our existing seas. It is well known that, when organic bodies, either animal or vegetable, are deposited upon land, or in shallow waters, or are buried slightly beneath the land surface, decomposition immediately begins. The combination of elements is broken up, and complete dissolution of the body is the final result. The gases that are generated escape into the atmosphere, and these, as a rule, being lighter than common air, are lifted by the heavier body to an altitude where the tenuity of the air equals that of the gas, where, it is reasonable to assume, a complete separation of the elements that form the gas occurs, and the separated atoms of matter fall back to earth to enter into new combinations. But when a body is deposited in deeper waters, the air is excluded, and it may remain for a long period before chemical changes occur in the tissues. It is soon covered with the silt of the sea. This fine mud, impervious to air, continues to accumulate, as other organic bodies are deposited, and the process of decomposition may be arrested or measurably retarded for ages. The accumulations of silt and other matter continue to increase, until finally there is a sufficient weight of superincumbent matter to wholly confine the gas that may be generated.

To illustrate: There is a vast body of water just north of the equator in the Atlantic Ocean, known as the Sargasso Sea. This is in a region of comparative calm so far as the winds and oceanic currents are concerned. This vast space, hundreds of miles in extent, is full of great masses of floating seaweed. It is not uncommon to find solid masses of these marine algæ covering areas of 700 or 800 square miles. Some species of these seaweeds are of gigantic size. They grow at the surface of the water and are continually sinking to the bottom of the sea, where they are mixed with the silt and more or less animal matter. When the deposition of this organic matter ceases, the accumulations of silt will steadily increase until the whole mass of vegetable matter is buried hundreds of feet in oceanic mud. Later on chemical changes will occur in the silt itself, as well as in the buried mass of vegetation. The mud will become indurated, and finally hardened into shales, or other forms of rock. By natural process the vegetable matter will be changed into peat or coal; or, if the process of decomposition is more rapid and complete, the final result will be oil fields and gas areas. Many of the processes of nature are inconceivably slow, and man cannot estimate the time required to produce a geological formation except by ages of indefinite extent. Years and centuries in this connection become as mere seconds of time. These apparently slow processes will be continued without intermission century after century, until finally a great geological formation is built up, and the ocean itself is shifted to another quarter of the earth.

This shifting of oceans and seas has continued for measureless ages. The land areas in which our gas fields lie were for inconceivable periods beneath broad seas. The rocks at the various gas horizons, and those above and below them, are full of the remains of organic bodies similar to those that inhabit existing seas. Thousands of species of shell-fish have been identified, but how many thousands of species once existed of which no trace has ever been discovered is wholly beyond conjecture. It is enough to know that these fish existed in some waters in such vast quantities that the oyster beds and mussel shoals of the present day are insignificant in comparison with them. In hundreds of places where limestones occur masses of the stone, dozens of feet in thickness, are composed wholly of the perfect or comminuted shells of ancient orders of these fishes. In fact, almost the entire limestone formation of the globe is composed of the comminuted shells of these denizens of ancient waters. It is reasonable to assume that the softer portions of these animals contributed largely to the stores of gas and petroleum found in our limestones. In addition to these, countless myriads of crustaceans swarmed in the waters of the ancient oceans, besides other orders of animals innumerable. Some of the rocks disclose vertebrate remains, such as fishes and reptiles, in such vast quantities that they compose almost the entire body of the rock. Such for instance are some of the phosphate beds of the South.

Besides the animal remains found in the rocks, there are found vegetable remains that indicate a profuseness of growth in this kingdom far surpassing the product of the richest forests and jungles of the tropical regions of to-day. Many of the seas were filled with a plant growth similar to the seaweed of to day. Remains of these are found profusely through the rocks. Evidences of these plant growths are found in greater or less abundance in all the stratified rock deposits. All the great coal deposits of the earth are but partially decomposed portions of the wonderful vegetable growth of past ages.

More or less mineral matter enters into the structure of all animal bodies. The shells of oysters, crabs and turtles, and the bones of animals, contain a greater proportion, and these are the parts that are universally found in a fossil state. The softer parts of the body soon decompose, and the gaseous portions are dissipated in the air or confined in some reservoir. Trunks of trees are more readily preserved, and these are found in all states of preservation, from the semi lignitic state to that of pure coal.

Coal is found in various states of preservation. In the process of decomposition we have wood, peat, lignite, bituminous coal, cannel coal and anthracite. The last, anthracite, is virtually natural coke. It was once bituminous coal, but in nature's laboratory, or oven, it has been converted into anthracite by slow processes, but by the same laws that govern when bituminous coal is placed in the cooking oven. Coke is artificial anthracite, just as the gas evolved in a cooking oven is artificial gas. The texture of anthracite was modified by the condition of environment and the weight of superimposed strata during the process of gas elimination.

The preceding statements have been made for the purpose of showing that great masses of organic bodies, both animal and vegetable, capable of yielding gas in unmeasurable quantities, were distributed throughout all the stratified-rock deposits during the rock-building periods of the past. Gas and petroleum have been found only in the stratified rock deposits. They are never found in the granites or in other igneous rocks that are barren of organic remains. The sedimentary or stratified rocks of the various oil and gas areas lie over the igneous, or non-stratified rocks. If gas was generated in the lower rocks, it might readily by its expansive force propel itself into reservoirs in the superincumbent

strata, but petroleum would not ascend unless forced upward by hydrostatic pressure. But in face of the fact that neither gas nor oil has ever been found in the igneous rocks, none will care to assume that petroleum has been forced into its position in the superlying rocks by pressure such as suggested above.

Assuming that natural gas was generated in the rocks that now confine it, an examination of these rocks and contiguous rocks ought to determine as to the probability of the gas having been produced by a partial dissolution of the rock structure. Careful analyses of the gas-bearing rocks of Ohio and Indiana have been made from time to time, and it has invariably been found that the samples examined have undergone no material chemical change. In some localities the rock that forms the reservoir is a nearly pure carbonate of lime. In other localities it is a sulphate of lime or magnesian limestone. In all cases it is crystalline, or semi-crystalline, in structure. There has been no general decomposion of this rock or of that contiguous to it. The rock is composed of small crystals of lime with interstices between that form the so-called "pores" in which the gas is confined. The capacity of the reservoir is determined by the size of these interstices, the thickness of the rock, and its lateral extent.

With a knowledge of the fact that there has been no material change in the component elements of the rocks at the gas horizon, and the knowledge, also, that the underlying igneous rocks are barren of gas and have not the elements to produce it, it is easy to arrive at the conclusion that natural gas has been derived from the organic matter that was buried with the sediment that now forms the rocks. This is equally true of the gas found in Pennsylvania and West Virginia, as well as that of Ohio and Indiana.

Another fact in this connection is that all geological formations, from the Trenton group, upward, contain more or less gas and more or less petroleum. This is important considered with the fact that all of these formations and groups of rocks are full of organic remains. The Utica shales, overlying the Trenton limestone in Ohio and Indiana, have a maximum of thickness of 400 to 500 feet. They are usually black, and are in places highly bituminous. The Niagara limestones in Indiana, Kentucky and Tennessee contain more or less petroleum distributed almost universally through their strata, and in some localities considerable deposits of asphaltum occur. The Devonian shales of Tennessee, Kentucky and Indiana are rich in petroleum, but as a rule they lie so near the surface that the oil has largely evaporated or changed into gas, and has been dissipated into the air. In Meade county, Ky., and Harrison county, Ind., the limestones underlying the Devonian shales yield gas in paying quantities and also petroleum to some extent. Petroleum is mentioned in connection with natural gas for the reason that they are uniformly associated in the rocks or are found contiguous to each other, and it is assumed they both have the same origin. In fact, petroleum is the residuum of natural gas, just as asphaltum in many places is known to be the residual matter of evaporated petroleum. Petroleum is the only element now left in the rocks from which the supply of natural gas may be replenished.

The fact seems plain that natural gas is of organic origin, though it may be remotely so. First, petroleum is distilled, and following, possibly, gas is generated. This being true, why do not all areas where stratified rock occur have natural gas? First, because over many areas where organic matter was deposited in large quantities the conditions were such that immediate decomposition took place and the gas escaped into the air. Second, in many large areas where gas was generated, probably in immense quantities, subsequent disturbances fractured and fissured the strata to a great depth, thus releasing the imprisoned gas from its reservoir. Then there were doubtless large areas of the ancient oceans almost barren of organic life, just as portions of existing seas are almost destitute of life, and these areas are naturally destitute of gas and petroleum in paying quantities. The meaning of "sedimentary" and "stratified," when applied to rock formations, is generally understood. It is known that these are the rocks that were formed by deposition in seas and other bodies of water. The matter composing these rocks was first deposited as mud, sand or gravel. The rocks derived from these depositions form shales, sandstones and limestones, with various minerals interspersed through them. It is doubtless true that mechanical and chemical action both contributed to produce the transformation from mud and sand to stone. It was during this period of metamorphic action that the petroleum confined in the rocks was distilled and the natural gas generated from the decomposing organic matter. The organic matter confined in the sediment during the period of metamorphic action was wholly decomposed. Nothing remains of it except the mineral portion. There is no further store upon which nature can draw to replenish the oil and gas fields when they are once exhausted. Ultimate exhaustion is an absolute certainty. The gas reservoirs will become as barren as will the coal fields when the coal has all been mined.

[To be continued.]

The Petroleum Industry of Austria-Hungary.

By Mr. Arthur W. Eastlake.

In the Province of Galicia the oil springs have existed from time immemorial, but the active development of the industry dates only from the introduction of the Canadian system of drilling in 1882, since which time it has made rapid strides. Previously the method of obtaining the oil was rude and primitive, even after the introduction of steam power, and it was considered a creditable achievement to sink a well to such depths as 200 ft. or 300 ft., an operation which took many months. The Canadian system of drilling may be said to have completely revolutionized the industry. It has now almost totally superseded all other methods of drilling, and wells of 1,200 ft. or even 1,500 ft. are constantly being sunk. The oil zone is situated on the northern flanks of the Carpathians, and extends from Neu Sandez in the west to Sloboda-Rungorska, near Kolomea, in the east, a distance of about 220 miles, the oil belt being about 40 miles in width. Its general direction is northwesterly and southeasterly. The oil industry in Austria-Hungary is protected by an import duty of 10 florins per 100 kilograms on refined oil, and 2 florins 40 kreutzers on crude petroleum. Galicia does not produce sufficient oil to supply the requirements (1,750,000 barrels) of the Austrian-Hungarian Empire, and the deficiency (750,000 barrels) is chiefly imported from Russia.

Common labor is plentiful and cheap in Galicia, 20 cents to 25 cents per day being the average wage. Skilled labor, however, is not so abundant; indeed, it is frequently difficult to obtain a really good smith, carpenter or machinist. The men working at the drilling rigs, as pole wrenchers and scaffold men, obtain from 40 cents to 50 cents per day of 12 hours. The wages of a good smith vary from $25 to $40 a month. Other men who have any claim to be reckoned as craftsmen get on an average about $25 a month. Galician drillers get about $50 a month, and often a certain small sum (generally a florin, or say 40 cents) for each meter drilled. The drilling is often taken by contract at prices ranging from $1.50 to $2 per foot, the contractor finding the labor required for the actual drilling, and the owner of the well providing the necessary plant, machinery, motive power and all other labor.

The quality of the petroleum obtained in Galicia varies considerably in different parts of the country, ranging from a heavy dark green colored oil, with a specific gravity above 0.900, to a light reddish brown colored oil with a specific gravity below 0.800. One of the petroleum properties, under the management of the author, yielded oil which burned with ease in ordinary lamps without undergoing any process of refinement. This kind of oil is obtained at several places in Galicia, but has never been found in any considerable quantity, the wells sunk in this class of strata yielding as a rule only from half a barrel to two barrels per day. The specific gravities of the oil produced on the same property, and from wells close to each other, vary considerably. Refiners state that the percentage of burning oil varies from 40 per cent. to even as high as 70 per cent. In the author's opinion the average would be about 50 per cent.

Oil territories in Galicia are generally leased for 25 years, and the royalty payable to the lessor ranges from 10 to 40 per cent., together with, in most cases, a certain amount of cash. The lessee has also to pay for any damage to crops, etc., and a small sum per annum for all land occupied by him. This statement applies chiefly to estates of large landowners. The small plots of land held by the peasants can be obtained much cheaper. In this case, as a rule, a small sum, ranging from $25 to $100, and a royalty of a few dollars on each productive well sunk, paid to the peasant proprietor, will satisfy him for the grant of mining rights for 25 years, and in other cases a royalty of 1 to 5 per cent. is paid.

In locating wells it is the general custom to secure the services of the best-known geologist of the district. In commencing the development of a new territory, the best course to pursue is to ascertain the direction of the oil-belt by trial shafts, examination of outcrops, shows of oil and other indications, and then to sink wells across it about 75 to 100 feet apart. A property would not be considered as properly tested if less than four or five wells had been drilled.

Many systems of drilling have been tried in Galicia, but the Canadian system, adapted and modified to suit the requirements of the country, has now practically superseded all the others. For this the derrick and engine employed are very similar to those used in America. The tools used include poles, jars, sinker-bars, guides, bits, chisels, sand pumps, reamers, wrenches, fishing tools and others, which oilmen will readily recognize.

In drilling a well the work is done in 12-hour shifts, from noon until mightnight, and from midnight to noon. The average time in which a

well of 1,000 feet is drilled in Galicia on the Canadian system with Canadian drillers is about 58 days, although many wells are sunk in six weeks or even in less time. In the Sloboda-Rungorska field a well has been put down 680 feet in 18 days, and at Kryg a well of over 600 feet was finished in less than a week.

There are very few pipe lines in Galicia, the oil being mostly carted in barrels from the wells to the nearest station, a tedious, wasteful, and therefore costly and inefficient way of dealing with it—the roads on the lower slopes of the Carpathians being, except during a few months of the year, either covered with three feet or four feet of snow or knee-deep in mud.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

LAST month we published the leading features of the franchise asked for by the promoters of the Banks Gas and Electric Light Company, a corporation which proposed to operate an opposition lighting plant at New London, Conn. The petition, which was before the Connecticut State Legislature, is not likely to secure the assent of that body, for when it was put on its passage in the Senate a motion to recommit secured every vote save one.

THE new machine shop of the Coe Brass Manufacturing Company will be 40 feet wide and 300 feet long, and two stories in height. The building is to be designed and built by the Berlin Iron Bridge Company, and will be covered with the patent anti-condensation corrugated iron covering of that Company.

WE have been informed that Messrs. James Hardee, James A. Welsh and Henry Joseph have filed a certificate purporting to incorporate the Flatbush and Flatlands (L. I.) Gas Light Company. The capital is returned at $30,000.

THE Trustees of the municipal lighting plant of Wheeling, W. Va., have been seeking a way to raise the sum of $30,000, which amount is needed to restore the balance or equilibrium of the profit and loss account respecting the operation, up to May 1st, of the electric lighting annex. At a session of the Councils, held June 27, Mr. Dobbins, in the First Branch, offered a resolution authorizing the Mayor and Committee to negotiate a loan of $30,000, giving a mortgage upon the city light plant, it being property acquired since the last regular city loan was authorized by the voters. The First Branch passed the resolution, but when the matter came up in the Second Branch Mr. Maxwell moved to amend by striking out certain words, and then modified his method by offering a substitute to the effect that the Finance Committee be authorized to provide a sufficient sum of money, as soon as possible, to relieve the stringency in Gas Board affairs. He said he had some doubts as to the ability of the Mayor and Committee to negotiate a loan, and he wanted to see the matter come up in the regular way, through the Committee, who could see what could be done. Mr. Wheat added that the situation was somewhat precarious, and that the need for the money was urgent. One party (a Mr. Floersheim) was carrying a claim for about $17,000 for nearly a year, and was naturally anxious to have a settlement. The substitute offered by Mr. Maxwell was adopted, and the same was subsequently concurred in by the First Branch.

WE understand that the proprietors of the Elizabethtown (N. J.) Gas Company will extend the mains to the adjoining towns of Linden, Cranford and Westfield. This looks to be a common-sense, business like move.

WE regret to be called on to note the sudden death of Mr. Peter Edward De Mill, Jr., son of the late Peter E. De Mill, of Detroit, Mich., who lost his life through the overturning of a pleasure boat while cruising on Lake Michigan, on the afternoon of June 27th. We hope to be able to give some account of his life in a future issue of the JOURNAL.

JOHN CREMONY has instituted suit for $20,000 against Mr. John Shirley and the San Francisco Gas Light Company. In his complaint Cremony alleges that on the 30th of March last he slept in a house owned by Mr. Shirley, and to which gas was supplied by the San Francisco Gas Light Company. The gas fixtures were out of order and the apartments became filled with gas that escaped from the pipes. Cremony was asphyxiated to the point of unconsciousness, reaching, as he alleges, a condition bordering on death, and so remained until restored by physicians. He urges that as the escape of gas resulted from the carelessness of Shirley and the Gas Company, they be obliged to pay him for the injuries inflicted. Mary Martin, who was overcome at the same time, sues for $5,000. Mr. Shirley and the Company replied that the accident was entirely due to Cremony's negligence in extinguishing the gas.

IN the Wilmington (Del.) Court of Chancery, Austin Harrington and Herbert H. Ward, counsel for the Oxy-hydrogen Gas Light Company, of Wilmington, a concern in which J. Edward Addicks is the moving spirit, applied to have Mr. John F. Tyler, of Boston, appointed a commissioner to take certain affidavits. When these affidavits are taken, the counsel for the Company will file a demurrer in the injunction case in the Court of Chancery and hope to have it removed. The injunction restrains the Company from entering upon the streets of the city for the purpose of laying gas mains. The injunction was placed on the Oxy-hydrogen Company about two years ago by the late Chancellor Saulsbury, at the instance of Joseph L. Carpenter, Jr., J. Newlin Gawthrop and Samuel Chambers, Directors of the Sewer Department, and is against John Edward Addicks, Frederick P. Addicks, John E. Baker, Simon B. Coule and Samuel Austin, the Directors of the Oxy-hydrogen Company. The injunction was only a temporary one, but the defendant corporation never answered it, and it therefore holds as a restraining order until it is answered and the whole question decided.

AT a meeting of the Directors of the Paterson (N. J.) Gas Light Company, held on Wednesday, June 21, 1893, the following officers were chosen for the ensuing year: President and Treasurer, John Reynolds; Vice-President, W. L. Williams; Secretary, R. Schoonmaker.

"W. McD.," writing from Albany, N. Y., under date of July 1, forwards the following from the Albany *Morning Express*, of June 30: "Is it really natural gas that a Toledo (O.) Company would give the citizens of Albany, or is this another wild scheme like the driven well plant? A hearing was given last night by the Common Council Committee on Law, consisting of Aldermen Stevens, Fisher and Brown, to those interested in the natural gas project. The petition, as presented by Messrs. George P. Waldorf and Simon H. Kennedy, of Toledo, O., asks permission to lay, use and maintain service pipes in the city of Albany for the purpose of conveying and using natural gas for heating or illuminating purposes. The petitioners claim that gas for heating and lighting purposes can be furnished for at least one-half the cost at present incurred. Mr. Kennedy stated that if the syndicate he represented were permitted to serve the public with gas, it was its intention to furnish the city hall and the public schools free of charge, which would create a saving of at least $2,000 per year for heating alone. In answer to an inquiry from Mr. Stevens, Mr. Kennedy said that the nearest place to Albany using natural gas was Sandy Creek, which is situated about 20 miles above Rome. It is claimed by Mr. Waldorf that in the vicinity of Albany natural gas abounds, and can be readily supplied at small cost. He asserts that the gas can be used for generating steam, and can be made to produce heat by laying a coil on the grate of a stove or furnace, and then the heat can be regulated at will. The petitioners want two years in which to make their tests, and then if gas can be found in sufficient quantity they want the Common Council to grant a franchise for 10 years. Mr. Waldorf stated the Company he represents is willing to spend $50,000 in making tests in this vicinity; that if there is no gas it alone will be the sufferer; but if gas is found it wants protection and the privilege of supplying the gas, for heating purposes at least, and will furnish it at 30 cents per 1,000 feet. If the city then wants it for illuminating purposes the gas will be furnished for the same price. The only reason that the Company did not ask now to be granted the privilege of supplying the gas for illuminating purposes also, was that it would be interfering with a local industry; but if, after the citizens are satisfied that the gas is really for practical and not for speculative purposes alone, they wanted it for lighting the streets, public and private buildings, the syndicate would gladly furnish it for that purpose at the same price. If gas is not found within two years the plan is to be abandoned, but if it is found, then a franchise should be granted for the 10 years as applied for. The projectors assert that they do not want in any way to interfere with a local industry. Judge Smith, of Johnstown, appeared as counsel for Mr. Waldorf, and stated that the petitioners were acting in good faith, and felt confident that gas was as plentiful in Mother Earth but a few miles distant from Albany as it is in Toledo and vicinity. Mr. Waldorf also claims that by boring down about 2,800 feet a pressure of gas can be found equal to 400 pounds to the square inch, which will be a force sufficient to force the gas 40 miles. If the system should be adopted here, and if in the earth in the vicinity of the Helderbergs gas should be found, it would seriously affect the coal consumption, as the cost of fuel would be but one-half of that now incurred. It is also claimed that the gas can be used with absolute safety. Judge Thomas

F. Wilkinson appeared before the committee to find out what the gas scheme really was. He looked upon it rather suspiciously, but when Mr. Stevens told him that the committee would look into the practicability and feasibility of the scheme, he said he would wait. The committee then announced that it would make a report at the next meeting of the Common Council. Is there, or is there not a gaseous fortune within reach almost within the city limits? is the question that is agitating the mind of not a few Albanians."

THE exhibit at the World's Fair, of Messrs. Jas. R. Floyd & Sons, proprietors of the Oregon Iron Works, of this city, is located in the main Machinery Building, Section 26, Column O, 27.

THE following is from the Macon (Ga.) *Telegraph*, of June 29, 1893: "Mr. Joseph M. Boardman, one of Macon's oldest and most highly esteemed citizens, died at his home on First street yesterday afternoon at 5:45 o'clock. The sad news of his death cast a shadow of sorrow over the entire city, for throughout his long career of usefulness he had become greatly beloved by all who knew him. Mr. Boardman was in the 85th year of his age, and had spent the greater part of his business life in Macon. Joseph M. Boardman was born May 10, 1808, at Newburyport, Mass. As a young man he clerked in Boston and in New York City, until his health failed to some extent and he was advised to come south. He came to Darien, Ga., in the autumn of 1834, and there entered the employment of Messrs. Snow & Rogers—Mr. Rogers was the George T. Rogers so well known in the early days of Macon, and whose sons now carry on the business he started. In 1836 he moved to Macon, where he has resided continuously since. After working in the Post Office in Macon some time he set up in business for himself in a book store on the Second street side of the old Washington Hall, and had just purchased that building when it was destroyed by fire in 1856. He then moved into a store in the triangular block, facing Cotton avenue, about in the location of the building recently erected by Capt. R. E. Park. In 1857, after building the present Washington Hall block, he occupied the store on the corner of Mulberry and Second streets, until he sold out his book business, about 1871. He was agent for several fire insurance companies, among them the Southern Mutual, from 1854 until advancing age caused him to relinquish business, in 1887. He was elected President of the Macon Gas Light and Water Company in 1858, and remained in that official capacity until May, 1889, and was most active in advocating the building of the water works by that Company. On the organization of the Macon Savings Bank, in January, 1875, he was elected President and held that position until he resigned, in January, 1893, In 1840, he married Maria Therese Lord, who died without issue. In 1848, he married Caroline A. Pierpont, by whom he had ten children, four of whom survive him. He was again left a widower in 1881, and the following year he married Mrs. Elodia B. Russell, daughter of Sydenham B. Trapp, a well known resident of early Macon. For the third time he was left a widower, in 1891, since when he has steadily failed in strength. He was best known throughout the State as a bookseller, having supplied the school books of their day to many of the most illustrious of Georgia's sons, and the bar and its members could depend on finding books needed by the profession on his shelves when no one else kept them south of Baltimore. While steadily refusing the use of his name as candidate for any office, he served as chairman in the building of Christ Church, the Bibb County court house, and in other ways worked for the public good. He introduced building and loan associations in Macon. He was a Freemason of high degree, and a member of the Bibb County Cavalry, and afterwards of the Macon Volunteers (Company B) during the War." The funeral took place on the afternoon of June 30th, at Christ's Church, the Rev. F. F. Reese officiating. The interment was made in the Rosehill Cemetery.

THE voters of Hillsdale, Mich., having endorsed the project to establish a municipal arc lighting plant, the authorities have entered into a contract with the Westinghouse Company to install the necessary apparatus at a cost of $14,000.

THE following are the specifications agreed upon some time ago by the Light Committee of Montreal, Canada, for the government of bidders for the public lighting of the city.

Quality of Gas.—The gas furnished shall not be less than 18 candle power. The contractor shall furnish all the gas required for lighting the public lamps now located, and for those which may hereafter be located along the lines of the mains of the contractor, as now laid or to be hereafter laid, during such hours as the Superintendent of Lamps shall direct.

Service Pipes.—The contractor shall furnish and put down all service pipes required for said public lamps, with a regular fall towards the street mains, and keep in regular repair the portions of all service pipes below ground, and use for the said pipes and repairs only wrought iron pipes not less than 1 inch in diameter and wrought iron or malleable iron couplings, bends and elbows.

Burners.—The contractor shall furnish and apply without cost to the city, automatic regulator burners, each burner delivering not less than 4 cubic feet of gas per hour, and said burners shall at all times be kept clear of all obstructions, so as to deliver the gas at proper nominal rate of 4 cubic feet per hour, and any burner or burners that may have become worn or obstructed shall be changed as the Superintendent of Lamps may direct and without cost to the city; also, all service pipes for said lamps shall at all times be kept free by the contractor from any and all obstructions to the proper flow of gas.

Mains.—The contractor shall, when so ordered by the Light Committee, subsequent to a demand of at least eight citizen consumers, residing on any street or lane (provided such street or lane is not at a greater distance than 500 feet from any gas main already laid), lay the necessary pipes and connections to provide for such service to the citizens on such streets or lanes. All iron posts or brackets for public lamps shall be furnished by the city up to the number now in use, viz., 700; all new lamps or brackets that may hereafter be required shall be furnished by the contractor at his sole expense, but these also shall be placed and fitted up in a proper manner by the contractor, and at his sole expense, on any street, square or other public place as may be required for the service, and after being placed in position, said posts or brackets shall be properly painted by the contractor, and the whole subject to the approval of the Superintendent of Lamps.

Lanterns.—All lanterns required shall be furnished by contractor without cost to the city, and these shall be properly constructed and glazed, and at all points near fire alarm boxes colored glass shall be used for the same as may hereafter be directed.

Repairs.—All pipes, burners, cocks and lanterns must be furnished and kept in good condition by contractor, and all repairs thereto must be made within 24 hours after proper notification, and without expense to the city; also, any removals of lamps or lamp posts, caused by alterations to sidewalks or roadways to be at the expense and done by the contractor.

Damages.—In cases of damage to lamp-posts, lanterns or pipes, such as breakage, or by being displaced from a perpendicular position by frost or otherwise (excepting civil commotion or by riots), the same to be made good by contractor without cost to the city, provided the city shall furnish such lamp-posts only as may be required for the purpose.

Excavation.—All excavations for mains, service-pipes, or lamp-posts must be subject to the supervision of the Road Department, and all such work completed and roads restored to their former conditions to the satisfaction of the City Surveyor, subject to the conditions of the existing contracts in case of permanent pavements, and in default of the contractor not complying with this section, the City Surveyor shall have the right to do the work at the contractor's expense. The Superintendent of Lamps, under the direction of the Light Committee, shall have the power from time to time to order the lighting or extinguishing of any lamps as the exigencies of the public service may require, provided not less than 400 lamps are at any time required, and said lamps so lighted or extinguished shall be paid for or deducted *pro rata*, as the case may be.

Bonds.—Bonds to an amount, and with sureties satisfactory to the Light Company shall be required from successful bidders. In awarding contracts for street lighting, consideration will be given to the price at which the bidder offers to furnish gas to the public and to the city for other municipal purposes, and the contractor shall state in his tender the terms and conditions upon which the gas shall be furnished to private citizens, and shall also state where their works shall be established.

COMMISSIONER JACKSON, the practical member of the newly created City Lighting Board of Detroit, Mich., was asked some days ago if the Board would consider an offer from the Detroit Electric Light Company to sell its plant to the city, providing the company would agree to accept lighting bonds in payment, at five per cent. premium. When the bonds were advertised, a few days ago, the lowest responsible bid was five per cent. below par. Commissioner Jackson said the Board had no authority to buy the company's plant. They might, however, buy some of the wires and poles, and perhaps some of the towers of the Detroit Company, but as for paying the company in bonds at five per cent. above par, he did not consider the city would be making anything by doing so, as he believes the bonds will bring that premium in the open market when money gets easier. President Moran says the company is willing to sell to the city and will take bonds in payment at 5 per cent. premium.

THE Richmond (Ind.) Gas Company's stable and storage shops were damaged by fire on the evening of June 27th, to the amount of $1,200.

THE exhibit of the Bristols Manufacturing Company at the World's Fair will be found in Machinery Hall, Section 25, M. 24.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

MONDAY, JULY 10, 1893.

The Market for Gas Securities.

During the week there was marked improvement in Consolidated gas, although the transactions in the same were neither numerous nor heavy. The opening to-day (Friday) was made at 122½ to 123. The all at-sea condition of the money market is responsible for the depression of these shares, which certainly are worth 140. Equitable is bid for at 172½, and Mutual is in slight demand, at 139½ to 144. The extra dividend of 2 per cent. on Mutual account, which is now payable, makes the return on the stock this year amount to 8 per cent. At the figures above given Mutual looks to be a purchase.

Brooklyn shares are dull and drooping, but the reason for this is the general apathy with which manufacturing shares are regarded in view of the stringency in the money market. Williamsburgh and old Brooklyn ought to afford a good turn at the prices at which they are quoted. Chicago gas is somewhat stronger, at 69⅛ to 69¼, and Baltimore Consolidated shows no change from last week. Laclede common is reported at 15 to 16, and the preferred is quoted at 79. Bay State shows some improvement, at 13¾ to 14¼, and those conversant with the situation there claim that an amicable readjustment of the contending interests is all but reached.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 WALL ST., NEW YORK CITY.

JULY 10.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	122½	123
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	139	142
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	35	40
Preferred	5,000,000	100	80	85
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	113
Citizens	1,200,000	20	100	101
" S. F. Bonds	320,000	1000	—	103
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	60
Fulton Municipal	3,000,000	100	125	—
" Bonds	300,000		102	—
Peoples	1,000,000	10	—	92
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	—	123
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	150	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	72	73
2d " " "	3,000,000	1000	50	53
Bay State Gas Co.—				
Stock	5,000,000	50	13¾	14½
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	69⅛	69¼
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7.650,000	1000	85	90½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	25	—
Bonds	600,000	1000	85	90
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	190	191
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	54½	55
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			85	87
East River Gas Co., Long Island City	1,000,000	100	100	105
Bonds	500,000	100	100	102
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	15	16
Preferred "	2,500,000	100	59½	60
Bonds	9,034,400	1000	79	79¼
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	30	—
" Bonds.	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal			42⅝	43
Peoples, Jersey City		—	160	170
" " Bonds			—	—
Paterson, N. J		25	99	102
Rochester, N. Y		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71½	72¼
Washington, D. C.	2,000,000	20	240	240
Wilmington, Del.		50	59	88

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT COMPANY, DREXEL BUILDING, PHILA., PA., June 30, 1893.

The Directors have this day declared a quarterly dividend of two (2) per cent. ($1 per share), payable July 15, 1893, to stockholders of record at close of business July 5.

Checks will be mailed.

944-1 EDWARD C. LEE, Treasurer.

A Graduate Chemist,

with over four years practical analytical experience,

Seeks a Position with Some Gas Works

as Assistant to the Superintendent or Engineer. A very moderate salary will be accepted. Address

PERRY WILLIAMS,
942-4 134 Public Square, Cleveland, Ohio.

FOR SALE,

Two Westinghouse Engines, of 12 H.P. each.

Ten 12-inch Chapman Valves.

All in good order. Address NEW HAVEN GAS LT. CO.,
922-tf New Haven, Conn.

For Sale.

The Property of the St. Charles Gas Light and Coal Company

will be sold in liquidation, without limit or reserve, for cash, at the east front door of the Court House, in St. Charles, Mo., on

July 12, 1893, at 11 o'Clock, A.M.

For Particulars address

F. EGNER, 812 Security Building, St. Louis, Mo.
JNO. A. KELLAR, St. Charles, Mo.
942-3 P. BAUER, Belleville, Ills.

FOR SALE.

Three (3) Purifying Boxes, 4 Feet 10 Inches Square, in First-Class Condition. Trays Entirely New.

Address E. C. HATHAWAY, Supt.,
Capital Gas and Electric Light Co.,
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FOR SALE,

Two Ten-Inch Dry Center Seals,

in good condition, and one

Small Multitubular Condenser,

4 ft. diameter and 14 ft. high.
For particulars inquire of FRED. BREDEL, C.E.,
929-tf 118 Farwell Ave., Milwaukee, Wis.

MOSES G. WILDER,

Mechanical Engineer,

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A First-Class

MERCURY PRESSURE GOVERNOR

with Balanced Valves, for Gas Stoves or Furnaces.

Sent complete with Service Cock for $4, as a sample, to any address. Liberal discount for large orders.

FOR SALE,

A Set of Second-Hand Purifiers, 6 x 8 Feet,

in good order, with 6-inch Connections and Dry Center-Seal Will sell separately or together.

C. S. HAMMATT, Supt., Citizens Gas and Electric Co.,
937-tf Jacksonville, Fla.

FOR SALE,

An 8-Inch Displacement Exhauster.

Address MORRIS, TASKER & CO.,
937-tf Philadelphia, Pa.

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VALVES,

Double and Single Gate, ¾ in. to 72 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, Oil and Ammonia.

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Hydraulic Main Dip Regulators, Check Valves, Foot Valves, Yard Wash and Fire Hydrants.

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We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

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Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

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TREASURER'S OFFICE: 72 Kilby & 112 Milk Sts., Boston, Mass.

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In order to correct some of the drawbacks in existing apparatus, and to bring Water Gas Generators within the reach of all Gas Companies, I have completed a Gas Generator (which can be seen in daily operation) having many advantages over all others.

This Generator takes but little room. It requires no change to be made in the height or depth of gas houses. It is more easily repaired when necessary. It is simpler and easier operated. It makes *more good gas from a given quantity of stock.* It makes good gas from *cheaper stock.* It makes gas of *any desired candle power* up to thirty without smoke. It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.* I build these Generators with any required capacity from 3,000 cubic feet per hour upward.

In more than one-half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours*, all the gas needed for the *twenty-four hours.*

Everything is guaranteed, including durability and capacity of the Generator, the quality of the gas, and its cost.

Correspondence solicited.

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SIMPLICITY * EFFICIENCY * DURABILITY.

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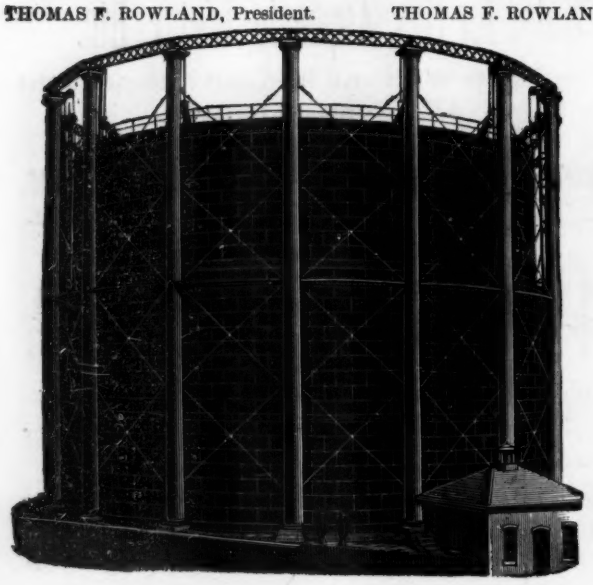

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RANGING IN PRICE FROM $3.00 to $63.00.

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The largest and best appearing line of Gas Stoves ever put on the market under one name.

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Our Catalog will be ready by 15th April, and it will be well worth waiting for.

Get your name on our list, and defer contracting for this season's supply until you have seen the 1893 Jewels.

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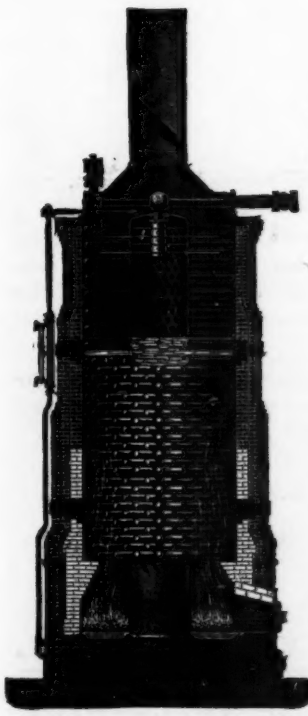
The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

Patented in America and Abroad.



100,000 HORSE POWER

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An Unparalelled Record, of Over Twelve Years, for Economy, Durability, Safety, and Efficiency.

A Common-Sense High-Pressure Boiler made in a Superior Manner.

We Solicit for it the Critical Examination of the Mechanical Profession and the Steam-Using Public.

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Standard Sizes, 50 H.P. to 500 H.P.

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THE PORCUPINE BOILER.
TRADE MARKS.

Special Sectional Boilers For Export.

The only Genuine Hazelton or Porcupine Boilers bear our Three Registered Trade Marks.

∴ BEWARE OF IMITATIONS. ∴

This Company is prepared to Manufacture and Furnish Plants of Boilers of any desired capacity, and will forward proposals and other information on application. All imitations of the substantial features of this Boiler are infringements, and will be prosecuted to the full extent of the law.

THE HAZELTON BOILER CO.,

Sole Proprietors and Manufacturers, NEW YORK, U. S. A.

Cable Address, "PAILA," NEW YORK.

WRITE FOR ILLUSTRATED CATALOGUE. Correspondence Solicited.

Long Distance Telephone, 1229-18th St., New York.

This Boiler is producing unequaled results in the works of most of the principal Gas Co.'s of the U.S., and in similar plants in Foreign Countries.

NOT CONNECTED WITH ANY OTHER CONCERN IN THE UNITED STATES.

CHAS. M. JARVIS, Prest. & Chief Engineer BURR K. FIELD, Vice-President. FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary

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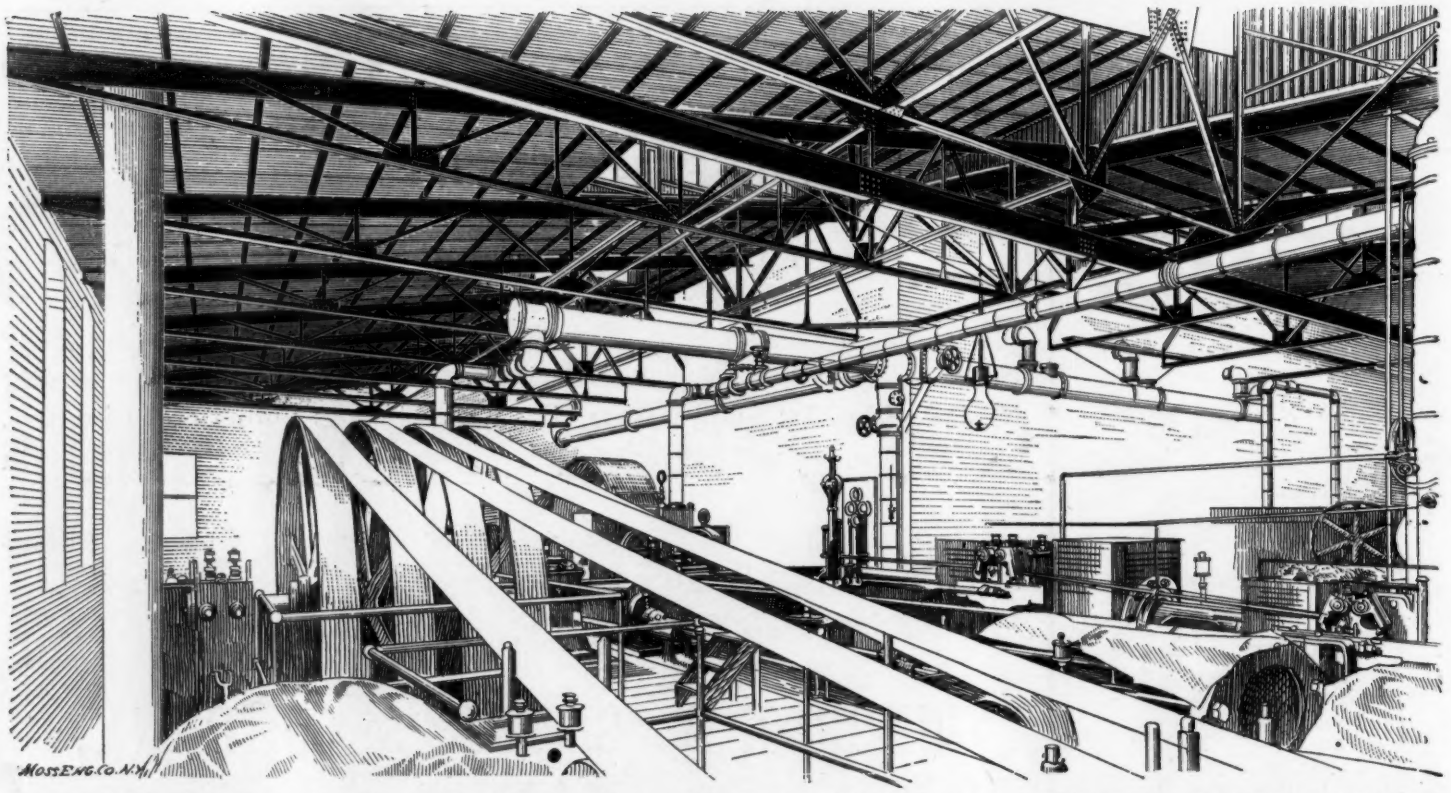

The above illustration is taken direct from a photograph, and shows the interior of the Dynamo Room in the Electric Light Plant of the United States Electric Lighting Company, at Washington, D. C. This roof is covered with our Patent Anti-Condensation Corrugated Iron, which we guarantee not to drip in the coldest weather, and which we also guarantee as fireproof.

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HIGH CANDLE POWER

FROM

GAS.

MR. WALTON CLARK, Assistant General Superintendent, United Gas Improvement Co.:

Dear Sir—In accordance with your request, I have made several tests of the new Welsbach mantel (called No. 169) for candle power and efficiency, and I herewith submit the following results:

	Candle Power.	Pressure.	Gas Consumed.	C.P. per Cu.Ft.
Average of Test No. 1,	67.05	.95 in.	2.6	25.70
" " No. 2,	63.86	1.00 in.	2.86	22.30
" " No. 3,	72.50	2.1 in.	2.87	25.26

The above averages are the results of trials on three different occasions, and in each case the mantles tested were made from a different lot of fluid.

The mantles used in the above tests were selected at random, and all had been dipped in kristaline and dried ready for shipment.

It is quite possible that better results could have been obtained by manipulating and readjusting the position of the mantles on the galleries, and also by waiting a longer period after burning off the kristaline; but I considered such fine adjustment undesirable in determining the commercial candle power.

These tests were made on a bar photometer against a regular Edgerton standard slit. The candle power of the slit was 6.18, and the gas used was Gloucester City water gas, 26 candle power.

Very truly yours,
(Signed) C. H. PAGE, JR., M.E.

WE ARE NOW PREPARED TO FILL ALL ORDERS PROMPTLY FOR

HIGH CANDLE POWER WELSBACH LIGHTS.

Gloucester, N. J. WELSBACH LIGHT CO.

THE CHEMISTRY OF ILLUMINATING GAS.

BY NORTON H. HUMPHRYS. Price, $2.40.

Orders may be sent to

A. M. CALLENDER & CO., No. 32 Pine Street, New York City.

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7 PLATES, AND 607 OTHER ILLUSTRATIONS. ROYAL OCTAVO, PAGES XX, 802. HANDSOME CLOTH, $7.50.

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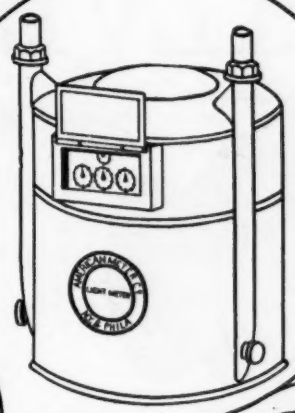

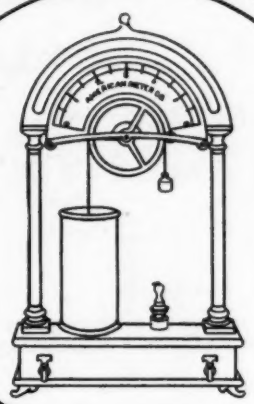

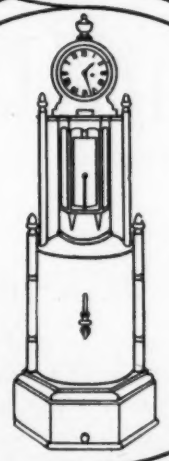

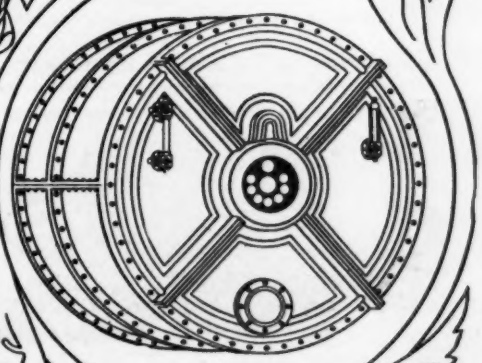

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NEW YORK and PHILADELPHIA.

CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

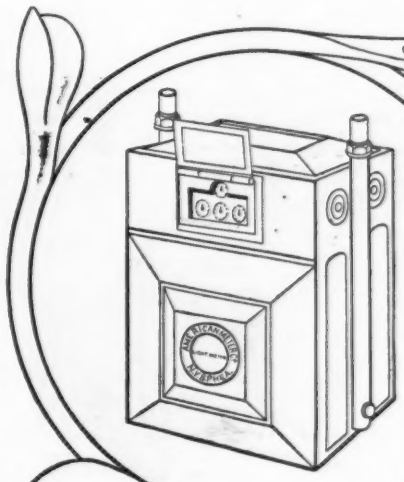
PUBLIC LIGHTING TABLE.

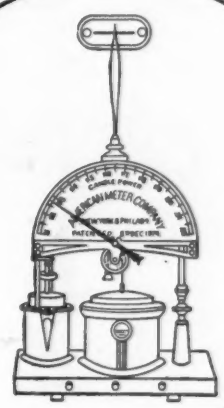
JULY, 1893.

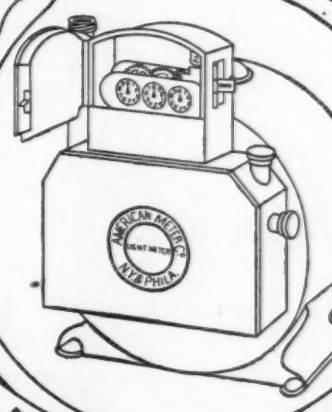
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	8.00 PM	10.40 PM	7.30	3.15
Sun.	2	8.00	11.10	7.30	3.15
Mon.	3	8.00	11.40	7.30	3.15
Tue.	4	8.00	12.00	7.30	3.15
Wed.	5	8.00	12.20 AM	7.30	3.15
Thu.	6	8.00 LQ	12.40	7.30	3.15
Fri.	7	8.00	1.10	7.30	3.15
Sat.	8	8.00	1.40	7.30	3.15
Sun.	9	8.00	2.20	7.30	3.15
Mon.	10	8.00	3.40	7.30	3.15
Tue.	11	8.00	3.40	7.30	3.15
Wed.	12	8.00	3.40	7.30	3.15
Thu.	13	8.00 NM	3.40	7.30	3.15
Fri.	14	8.00	3.40	7.30	3.15
Sat.	15	8.00	3.40	7.30	3.15
Sun.	16	8.00	3.40	7.20	3.15
Mon.	17	8.00	3.40	7.20	3.15
Tue.	18	9.40	3.50	7.20	3.15
Wed.	19	10.00	3.50	7.20	3.15
Thu.	20	10.20 FQ	3.50	7.20	3.15
Fri.	21	10.50	3.50	7.20	3.15
Sat.	22	11.10	3.50	7.20	3.15
Sun.	23	11.50	3.50	7.20	3.15
Mon.	24	12.30 AM	3.50	7.20	3.15
Tue.	25	1.20	3.50	7.20	3.15
Wed.	26	2.10	3.50	7.20	3.15
Thu.	27	No L.	No L.	7.20	3.15
Fri.	28	No L. FM	No L.	7.20	3.15
Sat.	29	NoL.	No L.	7.20	3.15
Sun.	30	7.50 PM	9.40 PM	7.10	3.30
Mon.	31	7.50	10.00	7.10	3.30

TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July.....	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45







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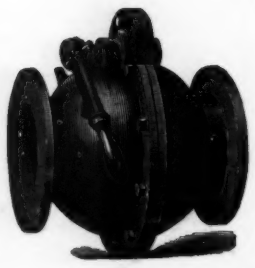
GAS AND BYE-PASS VALVES.



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For Continuous Records of

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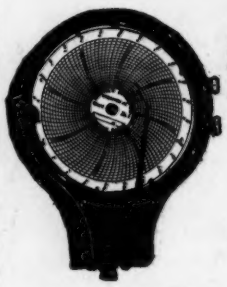

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Low in Price,
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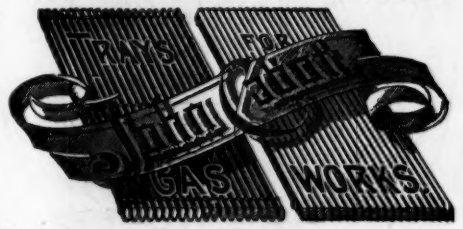

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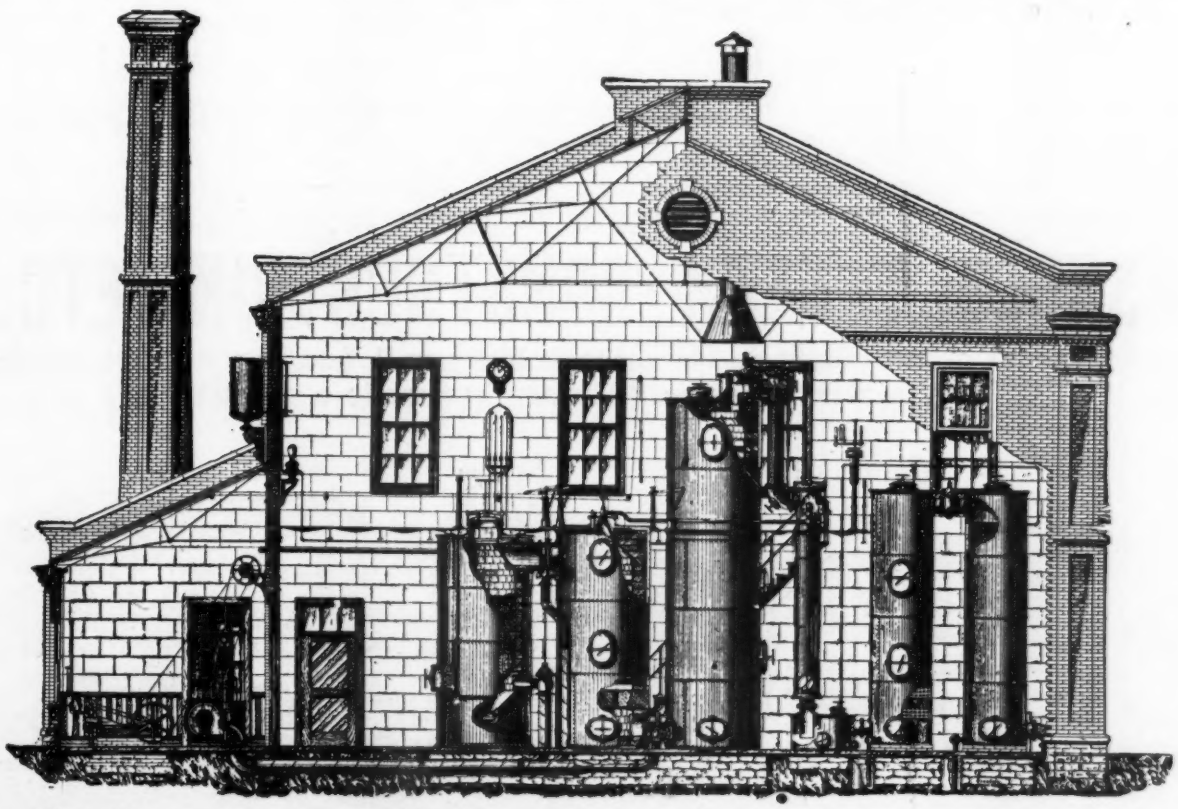

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Gentlemen—We are in receipt of your favor of the 16th, advising us the National Gas Light and Fuel Company, of Chicago, will discontinue their advertisement from July 1st, and offering us the space occupied by them since 1885.

In thanking you for remembering us and for the kind expressions made towards our Company, it affords us great pleasure to advise you that we have decided to accept your proposition, as we fully realize the excellent advertising facilities afforded us through the GAS LIGHT JOURNAL. In doing so we are also complying with repeated suggestions from the many friends we have gained in the fraternity, and who have proved so by their orders. Our previous hesitancy in extending our advertising was due to the fact that, with our best efforts, we were unable to increase our facilities to meet the growing requirements; but with our new shop, which will be completed this month, which is being fitted up with tools several of which are especially designed for the finishing of Gas Machinery and Apparatus, we feel confident of being able to turn out all work intrusted to us promptly and in a first-class manner. We have taken the precaution to provide for any extensions which may prove desirable, and we now hope to extend our business relations with the fraternity, and will do our best to deserve it by prompt and first class work and reasonable prices. Yours very truly,

THE WESTERN GAS CONSTRUCTION CO.
By O. N. GULDLIN, Prest.

GASHOLDER TANK CONSTRUCTION, ETC.

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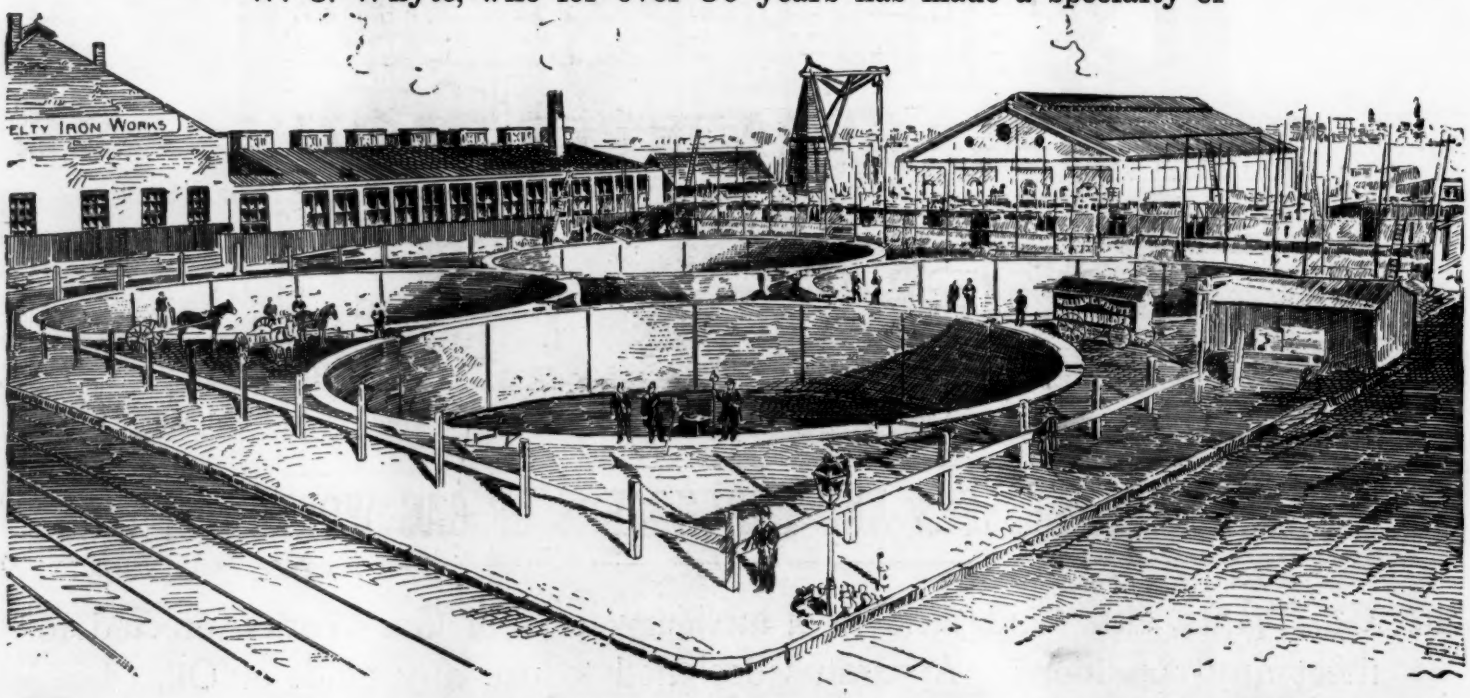

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AUTOMATIC GOVERNOR. OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT! WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION! REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE! IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

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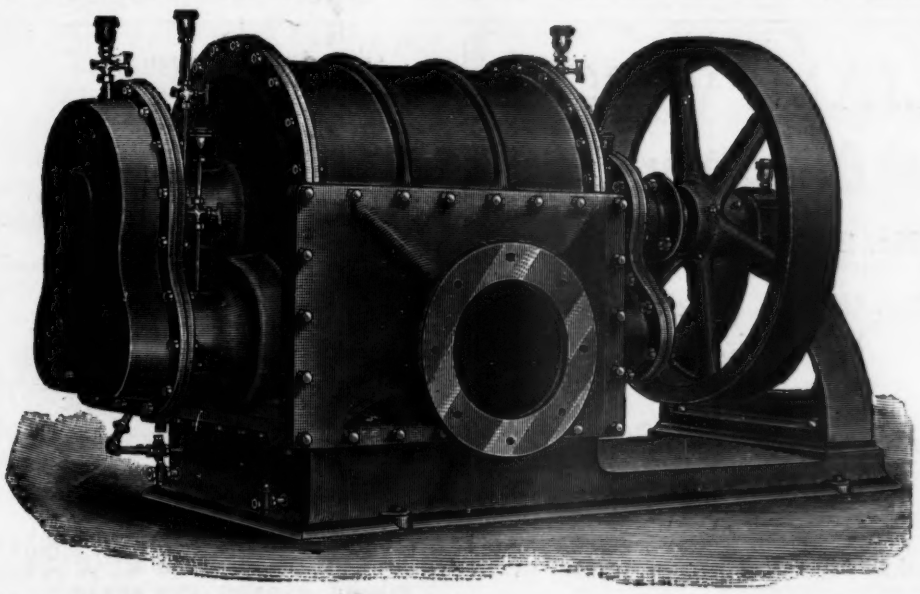

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Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

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Old Kentucky Shale, From Kentucky.

TRADE **O. K. SHALE.** MARK.

THE MOST VALUABLE GAS ENRICHER NOW AVAILABLE IN ANY DESIRED QUANTITY.

S. CALVERT FORD, Government Inspector at Washington, pronounces this Shale

"ONE OF THE BEST GAS ENRICHERS THAT HAS BEEN OFFERED TO THE TRADE."

He reports it as giving:

12,553 Cubic Feet of 50-Candle Gas,
or 10,460 Cubic Feet of 60-Candle Gas,

AN EQUIVALENT OF 627,650 CANDLE FEET,

And 808 Pounds of Merchantable Coke.

Single Carloads or more delivered at any required point in the United States or Canada.

Cargo Shipments from NEW YORK, PHILA., BALTIMORE and NEWPORT NEWS.

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Proprietors of the **BATHVILLE COLLIERIES** (which produce the celebrated **BOGHEAD CANNEL**), Shields, Shieldmuir, Drumpeller, and other Collieries. This Firm offer

STANDARD CANNELS,

Unequaled as Gas Enrichers.

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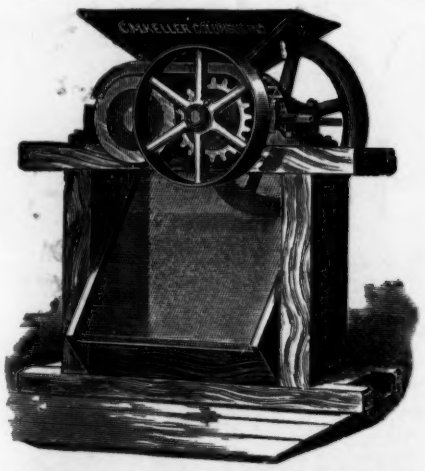

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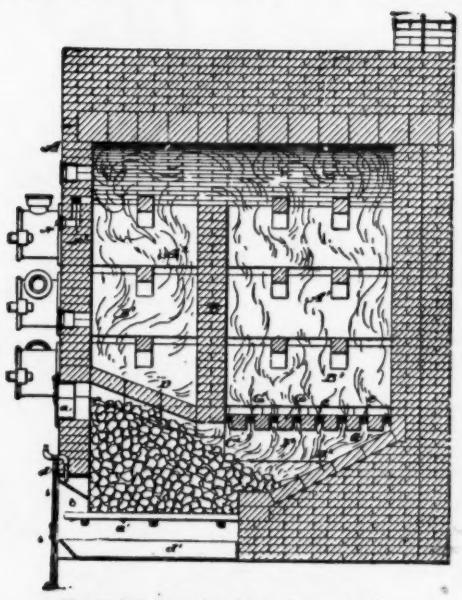

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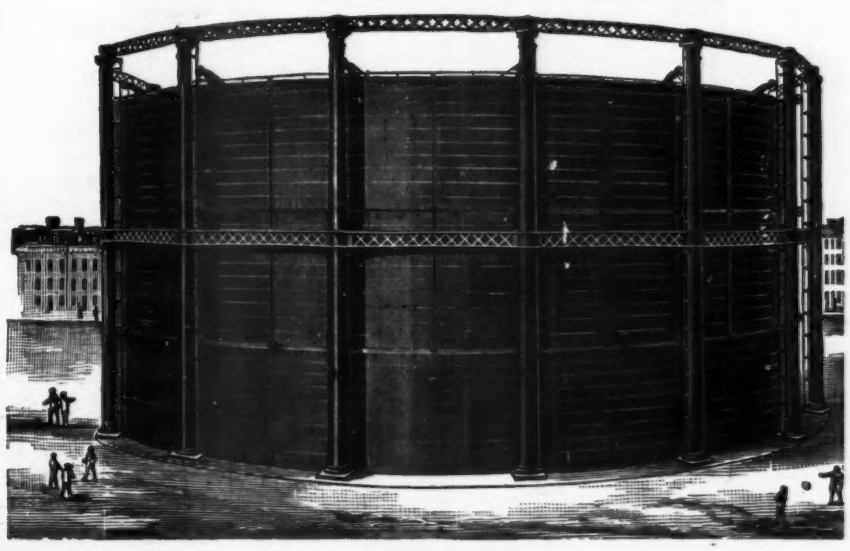

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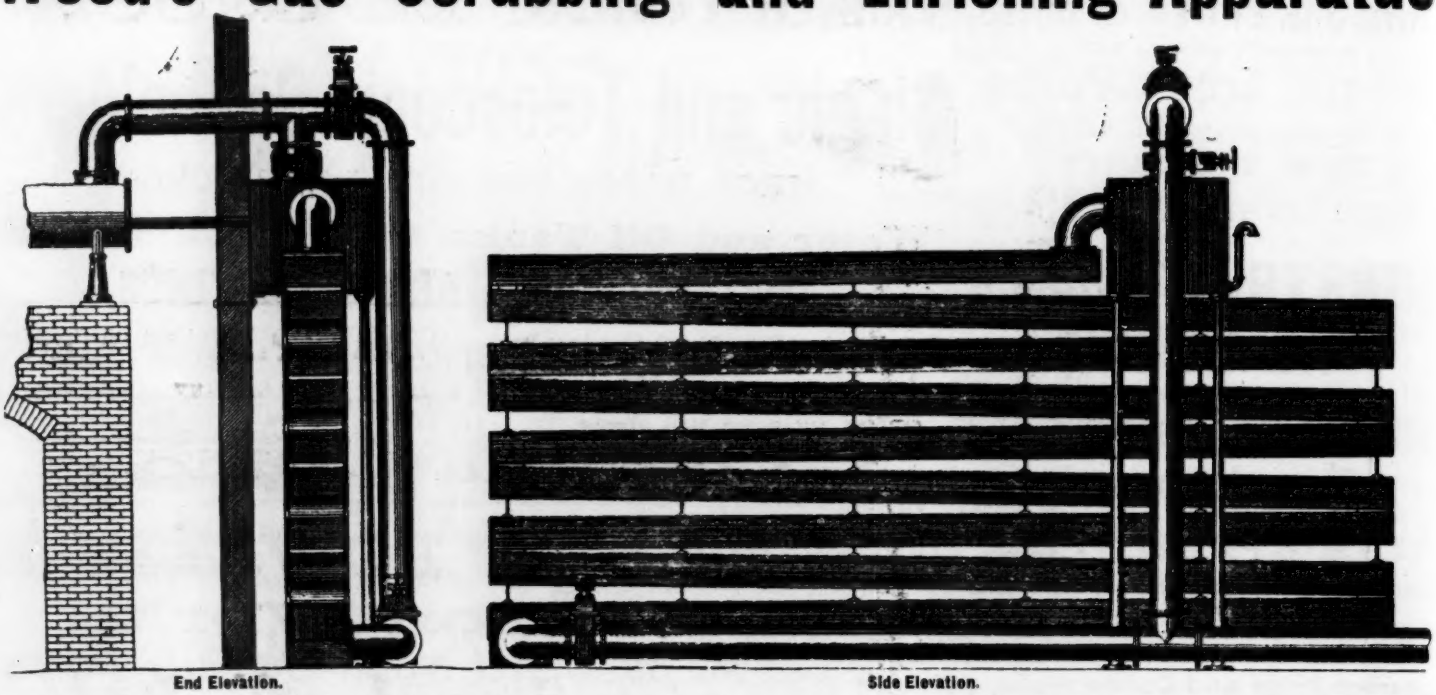

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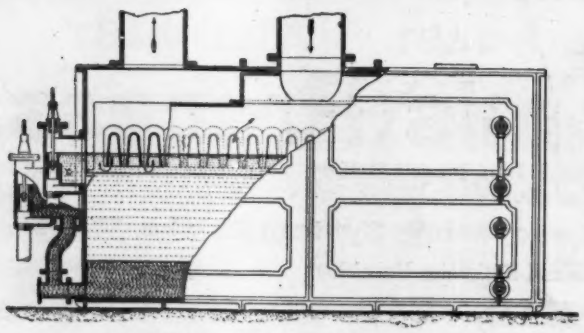

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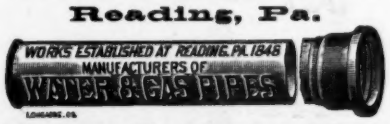

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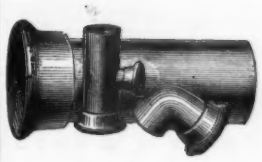

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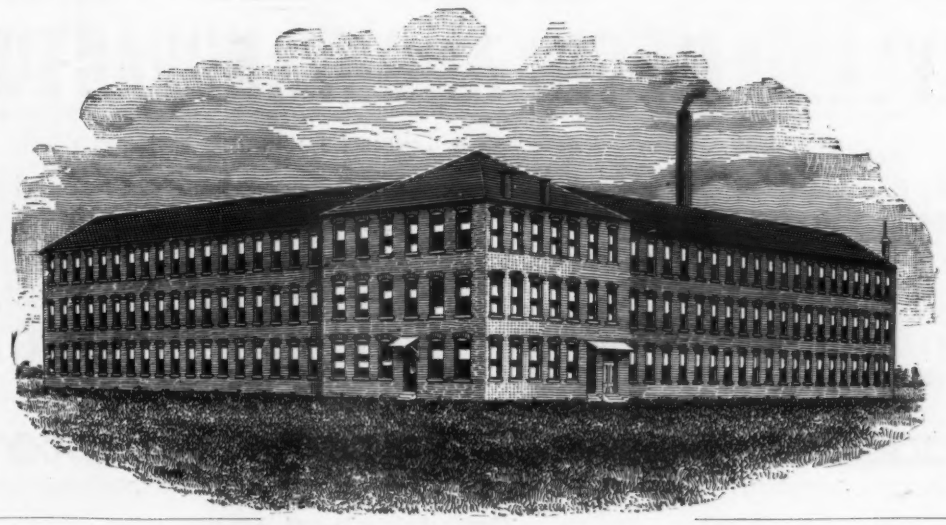

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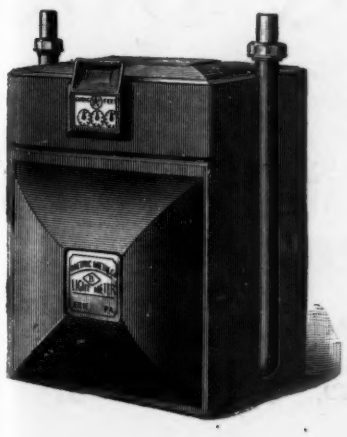

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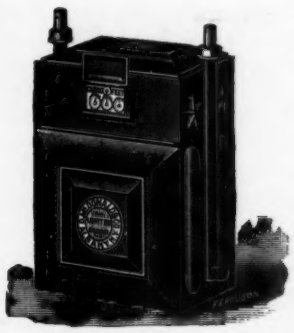
REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of all makers.



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METER PROVERS.
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SPECIAL.—Having purchased the sole right to manufacture and sell meters with the HEARNE IMPROVED VALVE, in the U. S., we respectfully solicit orders for the same.

The superior feature of this meter is that it avoids the danger of displacement of the valves, and consequent loss of gas, either in shipping, handling, or by dishonest consumers.

To designate from the regular Glover Meter, also made by us, we style the above the HEARNE-GLOVER Meter.

It is worth your consideration.

Full descriptive circular sent on application

$10,500,000

Is the estimated value of Gas consumed per year by

35,000 "OTTO" GAS ENGINES

NOW in use . . . . . .

To what extent does **Your Company** participate in this amount?

If you have not reached out for your share, it is time **now** to do so—for many good reasons:

1st. Because rates on Electric current are on the increase.

2d. Because improvements in our "Otto" Gas Engines have been wonderful and numerous, and have cheapened their cost.

3d. Because prices for Gas are lower than ever before.

4th. Because you can therefore make a price for Fuel Gas sufficiently low to ou master of the situation as regards competing systems of power—steam or ricity.

WILL IT PAY?

Mr. Thomas Fletcher, well known in the Gas Industry, gives his opinion on this question as follows:

"It is essential for economical working, and consequent low prices, that the plant as a whole shall be utilized as far as possible for the whole 24 hours every day, summer and winter alike. If this ideal state of things could be attained, about three or four times the output could be sold with practically no addition to the capital expenditure, *and consequently the profits would be increased to four or five times the present amount*, or even more, as the staff expenses would not rise in proportion, an account of £25 being quite as easy to deal with as one of £5, and requiring no additional office work. Instead of being the best customers, *shopkeepers* and *owners of large works* are really *the worst* the gas industry has to deal with, spite of the large total amount, and the reason is simple. The consumption is enormous during two or three hours in winter, entailing the necessity of enormous holders and very large distributing plant, all of which is absolutely idle during the summer. THE BEST OF ALL CUSTOMERS ARE THOSE WHO USE GAS FOR ENGINES, workshop and industrial purposes, as these will use a steady supply for about ten hours daily, winter and summer alike, and *these are the users worthy of the greatest consideration.* Next to these come the users of gas cooking appliances and gas fires, they also being practically steady users for long hours both in the winter and summer. Domestic lighting does not come out anything so favorably, as the consumption in the winter averages over double that in the summer, entailing the loss on idle plant during a large portion of the year. The dream of the gas engineer is a large summer and 'day gas' consumption, and on *these depend large profits and economical working.*"

REDUCED PRICES AND FULL PARTICULARS ON APPLICATION.

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